# Fanellan Hub 400 kV Substation and Converter Station

# Environmental Impact Assessment Report

# Volume 4 | Technical Appendices

## Appendix 13.3 – Drainage Impact Assessment

## February 2025

# Fanellan

400kV Switching Station and HVDC Converter Station

Drainage Impact Assessment
LT459-SWE-XX-XX-T-W-1001

SWECO

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# 1 Introduction

This Level 3 Drainage Impact Assessment (DIA) has been produced to identify any drainage issues which may arise upon the development of the Fanellan 400kV Switching Station and HVDC Convertor Station, on behalf of Scottish and Southern Energy Networks (SSEN) Transmission. This report will assess the impact of both foul and surface water drainage considering relevant information from the Drainage Strategy (DS). For the Drainage Strategy, see document LT459-SWE-XX-XX-T-C-0501. MicroDrainage was used to model the SuDS network.

This DIA covers the drainage system designed by Sweco only but allows for connection of third party designed elements to be integrated at a later date. Third party design includes roof drainage of the proposed buildings.

## 1.1 Site Location

The proposed Fanellan development lies approximately 5km southwest of Beauly within the Highland Council local authority. The OS Grid northings and eastings of the site are approximately 248404, 843094 (to the middle of the proposed development site). Access to the site can be taken from the A831 via the A862 and C1106 road from the Black Bridge. Refer to site layout drawing LT459-SWE-XX-XX-D-X-0001 in Appendix A for details and Figure 1-1.

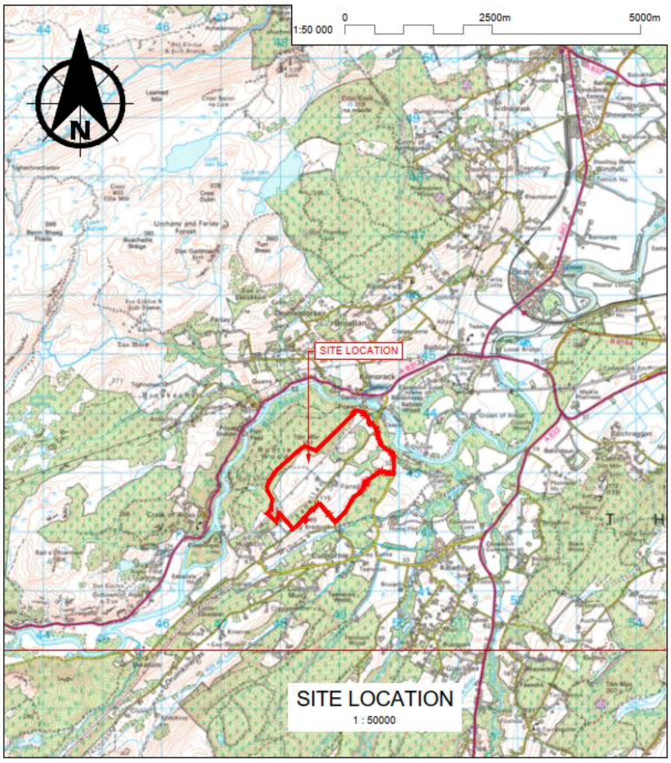



Figure 1-1. Site location to the south of the River Beauly

## 1.2 Purpose of this Report

The purpose of this DIA report is to detail the impact that proposed drainage will have on the Fanellan site. It explores the methodology of dealing with the surface water run-off and foul water from the proposed site. Furthermore, it gives details on managing groundwater and temporary drainage during construction (to ensure that this does not contribute to flooding), and the maintenance of the completed network. The report has been prepared considering the requirements and recommendations of the following documents:

- SEPA Water Assessment and Drainage Assessment Guide
- The Highland Council Flood Risk and Drainage Impact
- The Highland Council – Flood Risk and Drainage Impact Assessment: Supplementary Guidance
- CIRIA SuDS Manual C753
- SSEN Earthworks Specification SP-NET-CIV-501
- SSEN Drainage Specification SP-NET-CIV-502
- SSEN Pavements and Roadways Specification SP-NET-CIV-503
- SSE – HVDC Standardisation – Pre Riba-3 (PMI) Works (31st August 2023)
- Scottish Water Record Drawings

As well as the above noted sources of information, the DIA also relies on information from the DS.

# 2 Existing Site Description

The proposed Fanellan site is located on a mixture of arable land and grassland for agricultural use. The site is bordered to the north and west by mature trees of varying species and to the south and east by the existing unclassified council adopted road. The topography of the site generally falls from east to west towards the road, however, there are a number of undulations or 'knowes' and localised 'gully' type features to the north and southwest of the site. Within the proposed site boundary, there are existing dwelling cottages and farm building as well as unbound access tracks providing access to various points around the site.

## 2.1 Site Topography

A drone survey was carried out of the site by Cyber Hawk in June 2023 which provided a DTM point cloud survey, included in Appendix B. The highest point of the proposed site is approximately 147m AOD, at the mid-point of the site, falling to the lowest point approximately at 90m AOD at the northeast corner.

There are several drainage features located within the proposed site boundary in the form of land ditches or natural gullies which remove both surface water run-off and the ground water table.

## 2.2 Ground Conditions

Geotechnical Investigation (GI) was undertaken in August and September 2023. At the time of writing the DIA, the formal Factual Report has not been issued. The proposed development site consists of shallow superficials consisting of sand and cemented glacial till. A localised area of peat was encountered at one trial pit. Rock was encountered throughout the site between a range of 92.5m AOD to 146m AOD.

Over the course of the GI works, groundwater was struck at 21 locations within the proposed development site. The groundwater was encountered at its highest level (125m – 130m AOD) towards the west of the site. The proposed platform level is 127m AOD, therefore, groundwater needs to be managed and drained from the platform.  Currently, groundwater monitoring is ongoing at 3 locations and results will be provided in the Ground Investigation Report (GIR) along with a description of groundwater conditions encountered.

Groundwater was encountered both in the superficial Glacial Till and within fractured conglomerate bedrock. Due to the depth of the cuttings required for construction of Fanellan, and the potential inflow from fractured bedrock, this will need to be mitigated through the DS as described in Section 6.

## 2.3 Watercourses and Existing Drainage Features

### 2.3.1 Watercourses

The River Beauly passes the proposed development to the north and west, as it makes its way into the Beauly Firth, but is located approximately 725m beyond the proposed site boundary at its closest point.

There are a number of minor un-named watercourses / drainage ditches which are in close proximity to the site, all of which are culverted under the existing unclassified road running parallel to the eastern side of the site.

The first watercourse / drainage ditch is culverted under the road at Easting 248389 and Northing 842226 and flows in an easterly direction eventually discharging into the Lonbuie Burn. The watercourse / drainage ditch appears to drain to a naturally low-lying area of the site.

The second watercourse / drainage ditch is again culverted under the existing public road and flows in a northerly direction towards the River Beauly. The approximate Easting and Northing are 249077 and 843114, where it passes under the road. The watercourse / drainage ditch receives several ditches which drain the road and surrounding land.

A third un-named watercourse / drainage ditch is located at approximately Easting 248590 and Northing 842442 and is culverted under the existing public road. The watercourse flows in an easterly direction and eventually discharges to the Lonbuie Burn.

None of the watercourse / drainage ditches are monitored on the SEPA flood maps shown in Figure 2-1. Reference should be made to drainage drawings LT459-SWE-XX-XX-D-X-0501 and LT459-SWE-XX-XX-D-X-0502 in Appendix B which show the locations of the drainage watercourses / drainage ditches and an overview of the proposed surface water drainage network.

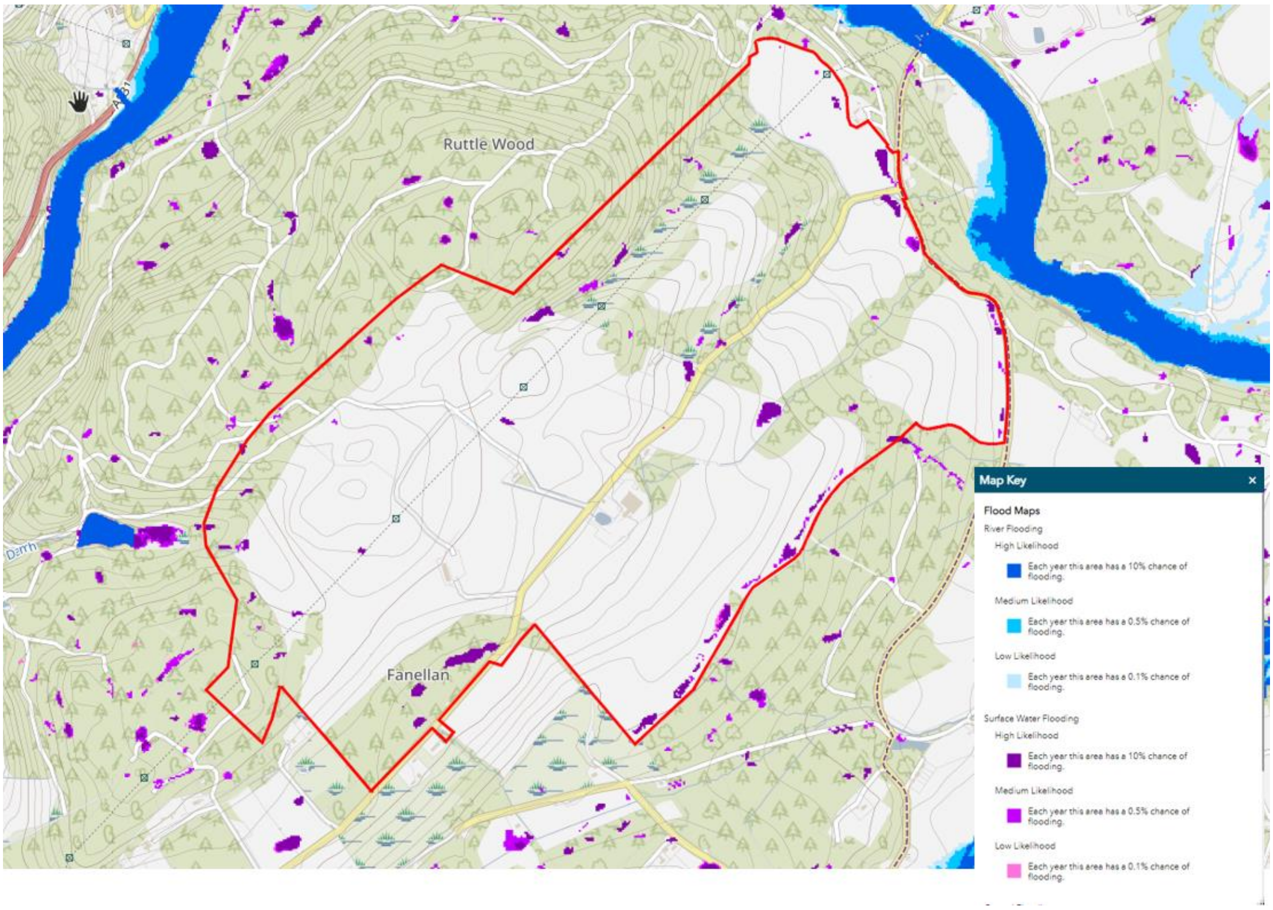



Figure 2-1 - SEPA flood map, taken from the Drainage Strategy

### 2.3.2 Drainage Features

There are a number of existing drainage features which comprise of land ditches used to cut-off the overland flows coming off the existing fields. There are also cut-off ditches along the existing road, however, many sections of these have no formal outfall and appear to empty via infiltration. The ditches are typically cut with near vertical side slopes.

To the southwest of the site, there is an existing small lochan which is located at Easting 247522 and Northing 842738 which part of the existing catchment of the site drains into. The lochan is topped up by the natural catchment draining into it and is a habitat of fish. The lochan is noted on the SEPA flood map shown in Figure 2-1. Lovat Estates currently owns the drainage in the undeveloped, greenfield area. There have been no existing drainage plans made available for the site.

There is an existing Scottish Water surface water main running along the Northeast of the site. For details on how this ties into the proposed drainage network, see LT459-SWE-XX-XX-D-X-0505 in Appendix B.

## 2.4 Flood Risk

A review of available information relating to flood risk of the site has been undertaken with the SEPA Flood Maps, Figure 2-1, confirming no river flooding present within the scheme extents. Some surface water flooding is noted in the map; however, this is considered minor in nature and is not located where the main substation is proposed to be located.

A full Flood Risk Assessment (FRA), document reference LT459-SWE-XX-XX-T-W-1002, has been undertaken and is to be read in conjunction with this DIA.

# 3 Proposed Development

The proposed Fanellan development shown in Figure 3-1 (and site plans, see LT459-SWE-XX-XX-DX-X-0001, LT459-SWE-XX-XX-DX-X-0002 and LT459-SWE-XX-XX-D-X-0003 of Appendix A) consists of a 240,000m$^2$ platform area with associated 400kV substation and associated building constructed on top. The area is split into two 'halves': the proposed switching station and the proposed convertor station. The planning boundary area encompasses 233Ha post development. The earthworks platform sits at a level of 127m AOD and incorporates a number of landforms (landscape bunds) which shield the buildings and associated substation infrastructure from view.

Figure 3-1. Fanellan Site Layout

Access to the substation will be via a 5m (minimum) wide asphalt access road and there will be a series of internal asphalt bound access roads within the perimeter of the substation. The switching station area of the platform will be formed of a build-up of a minimum of 1m crushed rock and will be predominately free draining material. The convertor station area of the substation will consist of several buildings and hardstanding areas which will be impermeable. There will be welfare buildings included within the development which will be supplied with drinking water and there will also be a foul water system included.

The substation will be surrounded by a security perimeter fence and there will be associated unbound access tracks providing maintenance access to overhead line towers and existing rights of access.

# 4 Surface Water Drainage

## 4.1 Use of SuDS Principles

The main impermeable areas on site are the HVDC convertor station, comprising of building roofs and hard standing areas as well as the granular platform where the switching station is situated. Also, surface water will be generated from associated access roads and tracks.

All surface water generated by the site will be drained using Sustainable Drainage Systems (SuDS) principles. This is in accordance with the requirement for SuDS in all new developments in Scotland according to The Water Environment (Controlled Activities) (Scotland) Regulations 2011. This will follow the requirements of the SuDS Manual C753 noted in Table 4.1.

Table 4.1 - Requirements of SuDS Manual C753

| | |
|---|---|
| Prevention | Prevent run-off of water with particular focus on polluted water. |
| Control at Source | Control the run-off where it occurs (tanks or pipes) |
| Control at Site | Control the run-off within the development boundary (swales basins, ponds) |
| Control in Region | Control the run-off from several sites within the vicinity of the developments (large wetlands, reservoirs) |

Further principles are noted below to ensure the safe operation of the final development:

- Removal of surface water from the access roads and hardstanding areas as quickly as possible to provide safety and to minimise nuisance to the travelling public. ·
- Provision of effective sub-surface drainage to maximise longevity of hardstanding areas and associated earthworks. ·
- Minimisation of the impact of the runoff on the receiving environment in terms of flood risk and water quality.
- Roofs, earthworks, access roads and other associated features are effectively drained. ·
- Consideration is given to future maintenance and operation of the systems. ·
- Climate change and possible changes in impermeable area is accounted for. ·
- The generation of waste during construction and operation is minimised.

LT459-SWE-XX-XX-D-X-0503 in Appendix B gives typical drainage details of a SuDS attenuation and treatment basin and wet swale, including maximum water levels. This drawing also includes typical details for filter drains, cut-off ditches and oil traps. These typical details were used to design the appropriate surface water drainage network for the Fanellan site. This is in accordance with recognised design manuals. All surface water discharges will receive appropriate levels of treatment and attenuation to comply with General Binding Rules (GBR).

## 4.2 Design Parameters

The overarching requirements of SSEN Drainage Specification, document number SP-NET-CIV-502, are as follows:

- 1 in 200-year rainfall return period protection for operations areas;
- 1 in 1000-year rainfall return period protection for critical equipment;
- 1 in 200-year rainfall return period protection for off-site flooding.

For the purposes of the Fanellan development, it is classed as critical equipment, therefore at the 1 in 1000-year return period the maximum depth of water above the finished level of the platform shall be less than 100mm. This 100mm value comes from the minimum level above the finished platform level upon which floor levels will be located. It will stop any occurrences of surface water flooding from entering any buildings.

Climate change will be added to the drainage modelling to ensure a robust system is put in place, in line with SEPA climate change guidance. The SEPA climate change allowances for flood risk assessment in land use planning, version 3, Table 2 recommends for the North highland river basin region a 42% uplift should be applied to all modelling to ensure the system is fit for future increased rainfall events.

Pipe networks and attenuation features shall be analysed using FEH 22 rainfall data for storm durations between 15 minutes to 10080 minutes.

The drainage design parameters follow the guidance set out in SuDS Manual, Sewers for Scotland v4.0 and SSEN specific guidance and are summarised in Table 4.2, below:

Table 4.2. Drainage Design Parameters

| Parameter | Value |
|---|---|
| Pipe networks will not surcharge above manhole covers | 200 year + 42% climate change |
| No flooding above 100mm on platform finished level | 1000 year + 42% climate change |
| No flooding of cut-off ditches and earthworks ditches | 200 year + 42% climate change |
| No flooding of attenuation features | 200 year + 42% climate change |
| Minimum pipe velocity from paved areas | 0.75 metre/second |
| Minimum vegetated SuDs system velocity | 0.3 metre/second |
| Roughness value ($k_s$) for carrier drains | 0.6mm |
| Roughness value ($k_s$) for combined drains | 1.5mm |
| Global Time of Entry | 5 min |
| Manning's (n) for new ditches | 0.045 |
| Manning's (n) for new wet swales | 0.100 |
| Minimum freeboard to open attenuation features | 300mm |

All SuDS principles used for the Fanellan drainage scheme conform to General Binding Rules 10, 11 and 21 of the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR). The SuDS schemes in this development consider current legislation such as CIRIA Publication C697 – The SuDS Manual.

## 4.3 Drainage Outfall

The options for dealing with the flows from surface water outfalls are based on the SuDS Manual C753 hierarchy as noted in Table 4.3 below.

Table 4.3 Outfall Hierarchy

| Option | Suitability | Comment on Suitability |
|---|---|---|
| Infiltrate run-off into the ground | The BRE soakaway test undertaken during the Geotechnical Investigation completed in September 2023 confirmed infiltration rates were visually confirmed as being poor on site. | Not feasible to use this method of outfall due to poor infiltration results. |
| Discharge run-off to surface watercourse | There are a number of unnamed watercourses located at the extremities of the site. Based on the proposed development levels, outfalls can be achieved to these watercourses. | This is feasible and allows for a number of outfalls if it is preferred to split up the development catchment. |
| Discharge run-off to surface or combined sewers | There are no Scottish Water sewers in the vicinity of the scheme. | Not feasible. |
| Discharge run-off into existing water features such as ponds | There are existing pond features in close proximity to the site which currently control run-off. These are located in private land and would need legal agreement to discharge into them. | Not feasible due to the ownership issues associated with this. |

## 4.4 SuDS Attenuation Areas

The outline drainage network and attenuation system are designed in accordance the SuDS Manual and The Highland Council specific flooding guidance. All SuDS attenuation features shall store surface water run-off to the 1 in 200-year return period rainfall event + 42% climate change. Further checks have been undertaken using the 1000-year return period to consider any adverse impacts on the surrounding area and identify exceedance routes. There are several catchment areas on the site which impact the Standard Average Annual Rainfall (SAAR). Data has been assessed using a number of FEH 2013 point data locations to accurately model each of the individual catchments at that location This results in differences in the calculated greenfield run-off rates for the catchments draining to each SuDS attenuation feature. Commentary is provided below on the selection of the discharge rates.

Due to the scale of the platform, it is proposed to separate the switching station and convertor station areas into separate catchments for attenuation purposes. This ensures that the catchments match (as far as possible) the pre-development discharge rates and ensure there is no increased downstream flood risk to the receiving watercourses. Due to the position of the site (broadly at the high point of the surrounding land), the watercourses are small in nature and cannot accept large discharges of run-off. All roads have suitable gradients and crossfalls to prevent water ponding.

Sweco are not responsible for the internal drainage of the site. A third party will undertake the roof drainage, and this will outfall to the Sweco system. Sweco does not propose to produce long sections for the drainage unless formally requested by the Highland Council as the current proposals are for planning and subject to development during the detailed design phase.

### 4.4.1 Switching Station Platform Area

The switching station area of the platform is approximately 15ha not including engineered slopes and natural catchments. It is proposed to split this area into two catchments for attenuation purposes and to match the existing catchment area as much as possible.

The greenfield run-off has been calculated for the pre-development area where the platform is located and is shown in Table 4-4 for either $Q_{bar}$ or $Q_{med}$ depending on the analysis used. A number of calculations methods have been used to compare greenfield run-off rates. As the ReFH 2 method is the most favoured under the SuDS Manual, analysis is required to be undertaken to compare the run-off rates with historical methods. The catchment areas noted in Table 4-4 include run-off from any verges, earthworks slopes and landscaping areas. The discharge rate for any SuDS feature shall be limited to this using a means of flow control (vortex control or orifice plate). Analysis has been undertaken to ensure any exceedance events from the attenuation features do not cause any detriment at the 1 in 200-year return period including 42% climate change.. It is proposed to use the 1m granular make-up of the platform to help attenuate rainfall over the platform area due to its size. It has been considered the granular platform make-up will have a voids ratio of 30% which will be suitable for storing run-off in the short term. The proposed areas for the attenuation within the platform are shown in the drainage drawings in Appendix B.

Table 4.4 Switching Station Catchment Discharge Rates

| Catchment Area (ha) | IH 124 Discharge Rate Return Period (litres / second) | ReFH 2 Discharge Rates (litres / second) | FEH Discharge Rates (litres / second) | Design Discharge Rate (litres / second) | Storage Volume Provided ($m^{3}$) |
|---|---|---|---|---|---|
| Switching Station East Catchment = 9.682 | $Q_{bar}$ = 22.8 | $Q_{med}$ = 17.4 | $Q_{med}$ = 23.1 | ReFH 2 $Q_{med}$ | Granular Platform =19,500<br>Detention Basin = 6545.0 |
| Switching Station West Catchment = 10.679 | $Q_{bar}$ = 26.0 | $Q_{med}$ = 39.6 | $Q_{med}$ = 35.9 | IH124 $Q_{bar}$ | Granular Platform =19,500<br>Detention Basin = 5695 |

The discharge rates in Table 4.4 have been calculated via a number of methods and the most conservative rate used in the design modelling. The new drainage networks discharge into drainage features such as ditches rather than formal watercourses and the time of entry from the new drainage network is far shorter than in the pre-development condition. Due to this, the discharge rates have been reduced to ensure no negative impacts throughout the lifecycle of the sub-station. All Greenfield run-off rate calculations are detailed in Appendix C. Additionally, the Switching Station East catchment outfalls to a small ditch which passes under several local authority roads via piped culverts of an unknown diameter and condition, therefore, a conservative approach has been taken. Similarly, the Switching Station West Catchment ultimately enters an existing fishing lochan to the south-west of the scheme extents.

Maintenance access shall be provided to the attenuation features in the form of unbound granular access tracks which, as a minimum, will provide access to all inlet and outlet headwalls with sufficient parking and turning areas for a van and trailer.

Further details of the Switching Station Western and Eastern Catchments can be seen in drawings LT-459-SWE-XX-XX-D-X-0507 and LT-459SWE-XX-XX-D-X-0508 in Appendix B.

These drawings show the SuDS train for the Switching Station Catchment for 1 in 200-year return period plus 42% for climate change. The drawings show flow paths, by indicating flow control chambers, and all drainage outfalls.

Also on these drawings, the 1m granular platform is labelled including 1-200 year and 1–1000-year return periods plus 42% for climate change. Along the road that surrounds the perimeter of the Switching Station, filter drains are predominantly used. Ditches are used for the permeable access tracks. Connections between the SuDS basins and the granular platform are typically carrier drains. There is also a drainage swale used in one area. All roads have suitable gradients and crossfalls to prevent water ponding.

Furthermore, these drawings show the appropriate exceedance routes, marked in black hatching as shown on drawing. The exceedance routes do not allow flooding as they are controlled by weirs and flow into appropriately sized cut-off ditches. Even in the event of over-topping, flooding of the surrounding area will not occur.

The MicroDrainage calculations for both catchments can be found in Appendix D.

### 4.4.2 Convertor Station Platform Area

The pre-development area where the platform is located greenfield run-off has been calculated as shown in Table 4.5 for either $Q_{bar}$ or $Q_{med}$ depending on the analysis used. A number of calculations methods have been used to compare greenfield run-off rates. As the ReFH 2 method is the most favoured under the SuDS Manual, analysis is required to be undertaken to compare the run-off rates with historical methods. It is proposed to attenuate run-off via in-line basins before discharging into the nearby watercourse. The discharge rate for any the feature shall be limited to this using a flow control device (vortex control or orifice plate). Analysis has been undertaken to ensure any exceedance events from the attenuation features do not cause detriment at the 1 in 200-year return period including 42% climate change. The discharge rate in Table 4-5 have been calculated via a number of methods and the most conservative rate used in the design modelling.

Table 4.5 Convertor Station Discharge Rates

| Impermeable Catchment Area (ha) | IH 124 Discharge Rate Return Period (litres / second) | ReFH 2 Discharge Rates (litres / second) | FEH Discharge Rates (litres / second) | Design Discharge Rate (litres / second) | Storage Volume Provided ($m^{3}$) |
|---|---|---|---|---|---|
| HVDC Convertor Station = 7.898 | $Q_{bar}$ = 56.2 | $Q_{med}$ = 34.5 | $Q_{med}$ = 27.6 | ReFH 2 $Q_{med}$ | Detention Basin = 14265<br>Note: Volume of water storage is <10000$m^3$ |

### 4.4.3 Sub-Station Access Road

A 1.5km access road is provided to the sub-station off Fanellan Road near the U1604 junction. Once completed the road will have an asphalt surface of varying width which will generate run-off. It is proposed to treat and attenuate the run-off in a new wet swale to the west of Fanellan Road before discharging the network into an existing ditch which runs adjacent to Fanellan Road. The proposed discharge rates are noted in Table 5.6. The rates noted in the table below shall be updated as the design progresses based on the actual impermeable area draining to each SuDS feature. For Microdrainage calculations, see Appendix D. The discharge rates in Table 4-6 have been calculated via a number of methods and the most conservative rate used in the design modelling

Table 4.6 Access Road Discharge Rates

| Impermeable Catchment Area (ha) | IH 124 Discharge Rate Return Period (litres / second) | ReFH 2 Discharge Rates (litres / second) | FEH Discharge Rates (litres / second) | Design Discharge Rate (litres / second) | Storage Volume Provided ($m^{3}$) |
|---|---|---|---|---|---|
| Permanent Access Road Network AR-1 =1.100 | $Q_{bar}$ = 7.8 | $Q_{med}$ = 3.8 | $Q_{med}$ = 5.1 | ReFH 2 $Q_{med}$ | Detention Basin = 1463.11 |

| Impermeable Catchment Area (ha) | IH 124 Discharge Rate Return Period (litres / second) | ReFH 2 Discharge Rates (litres / second) | FEH Discharge Rates (litres / second) | Design Discharge Rate (litres / second) | Storage Volume Provided ($m^{3}$) |
|---|---|---|---|---|---|
| Permanent Access Road Network AR-2 = 0.500 | $Q_{bar}$ = 3.2 | $Q_{med}$ = 2.1 | $Q_{med}$ = 2.6 | ReFH 2 $Q_{med}$ | Detention Basin = 898.2 |

## 4.5 Oil Pollution Control

The Fanellan site will have many components which use or store oil-based products. It is proposed that where oil is stored, earthwork bunds will be used to contain any spillage or seepage. When a leak is detected, an alarm system will alert the sub-station personnel who will begin operating systems to direct the discharge of any contaminated water into any of the surface water drainage systems. Firstly, the contaminated water will be discharged to an above ground oily water mitigation system where it will undergo one level of treatment. The treated water will pass onto another level of treatment either filtration through a filter media or into a SuDS system such as a swale. The water will then move onto further treatment and attenuation within a SuDS basin to remove remaining oil pollutants. For an extra level of protection, all outfalls from SuDS basins will have penstocks and oil traps prior to discharging into the water environment.

# 5 Ground Water Drainage

Groundwater level monitoring and observations made during the ground investigation indicate that groundwater is shallow, and present in both the superficial Glacial Till (within granular sands and gravels) and the underlying bedrock conglomerate. Groundwater flow within the bedrock is expected to be predominantly within weathered rock and through fractures, evident within the conglomerate. The rate of flow of groundwater will therefore vary depending on the degree of fracturing. Deep cuttings into the bedrock for construction of the substation platform, will intercept groundwater during construction works. Calculations have been made on the likely groundwater inflows to current design cutting faces, using site specific information available and taking into account the likely permeability range, in the absence of in situ or site-specific data. Resulting inflows are as follows:

- Average 5L/s ranging from 0.2L/s to 17L/s in AC (W) noted pipes (SWE-XX-XX-D-G-0001)
- Average 8L/s ranging from 0.3L/s to 27L/s into DC (W) noted pipes (SWE-XX-XX-D-G-0003)

There is expected to be ongoing seepage of groundwater from the exposed cutting faces which will have implications for permanent design and will be managed accordingly. It is proposed to attenuate the ground water, where possible and dependant on flow rates, as it will be intercepted by the pipe network and distributed into the nearby surface water courses at much shorter durations than presently. It is expected that the rates above will be refined as more monitoring data becomes available from the boreholes drilled onsite. Cut-off drains and ditches have been designed to stop surface water from reaching earthwork slopes; the platform; and any access roads on site. Toe-drains will be installed at the base of any embankments to gather any run-off and protect the platform from flooding.

# 6 Foul Water Design

The foul water generated from toilets and any washing facilities (sinks and showers) provided within the proposed development will have to be treated and discharged to Packaged (Industry Standard) Treatment Plants on site. This is due to the absence of Scottish Water foul or combined sewers within the vicinity of the scheme. The design proposals for the Packaged Treatment Plants will adhere to British Water Flows and Loads – 4 Code of practice for industrial sites and SEPA WAT-RM-03 regulations. The final sizing of the Packaged Treatment Plants shall be agreed with SSEN and authorised by SEPA. It is assumed, at this stage, that usage will be low, but any overflow discharges will be subjected to SEPA approvals process. The foul network will be limited, and the divergent nature of the system means that cross contamination of surface water sewers from foul sewers is very unlikely. For the layout drawing of the Packaged Treatment Plants, including maintenance access, please refer to drawing LT459-SWE-XX-XX-D-X-0504 in Appendix B.

# 7 Temporary Drainage During Construction

Temporary drainage of surface water during construction will incorporate numerous features such as cut-off and pre-earthwork ditches. These have been permanently designed into the final drainage network to reduce the quantity of temporary drains required. These ditches will be hessian lined or grassed where there is excess sediment predicted. Temporary drainage also comes in the form of filter drains which are to be used where ditches are unsuitable due to site levels. These will treat and convey water. Sedimentation lagoons are to be used before discharging back into the environment. These will store run-off and allow the settlement of sediments. As before, flood risk will be reduced by controlling discharge rates into the downstream watercourse. All works will be supervised and inspected by SSEN to ensure that all works are constructed as per the detailed design drawings. This eliminates any possibility of cross contamination between the foul network and surface water network during construction.

# 8 Water Quality

Any surface water flows draining from the proposed development have the potential to adversely impact the downstream watercourses adjacent to the site. Table 8-1 notes the pollution hazard indices, from Table 26.2 of The SuDS Manual, for the types of land use that are proposed under the development. Overall, the hazard level associated with surface water flows are considered low based on the indices associated with the development.

Table 8.1 Applicable Pollution Hazard Indices

| | | Pollution Hazard Indices | | |
|---|---|---|---|---|
| Land Use | Hazards Level | Total Suspended Solids | Metals | Hydrocarbons |
| Other roofs (typically commercial properties/industrial roofs) | Low | 0.3 | 0.2 | 0.05 |
| Individual property driveways, residential carparks, low traffic roads (e.g. cul-de-sacs, homezones and general access roads) and non-residential car parking with infrequent change i.e. <300 traffic movements/day | Low | 0.5 | 0.4 | 0.4 |

From Table 26.3 of The SuDS Manual, suitable mitigation measures have been put in place to ensure sufficient treatment takes place to any contaminated water before it is discharged back into the water environment. Table 8-2 denotes the mitigation measures which are used on the development.

Table 8.2 Pollution Hazard Mitigation Indices

| | Mitigation Indices | | |
|---|---|---|---|
| SuDS Component | Total Suspended Solids | Metals | Hydrocarbons |
| Filter Strip | 0.4 | 0.4 | 0.5 |
| Filter Drain | 0.4 | 0.4 | 0.4 |
| Swale | 0.5 | 0.6 | 0.6 |
| Detention Basin | 0.5 | 0.5 | 0.6 |

Table 8-3 denotes the treatment train which is employed on the networks associated with the development which drain areas where contaminated run-off will occur. A minimum of two levels of treatment have been provided to ensure sufficient treatment is provided. A SEPA Simple Index Approach calculation has also been undertaken to confirm sufficient treatment is utilised.

Table 8.3 Proposed SuDS Treatment Train

| Network | SuDS Treatment 1 | SuDS Treatment 2 | SuDS Treatment 3 |
|---|---|---|---|
| HVAC West | Filter Strip | Detention Basin | - |
| HVAC East | Filter Strip | Swale | Detention Basin |
| HVDC Convertor Station | Filter Drain | Detention Basin | - |
| Access Road | Filter Drain | Swale | - |

# 9 Operation and Maintenance

After completion of the drainage components for the Fanellan development, SSEN will become the accountable body responsible for vesting and maintenance for the site. Tables from the Drainage Strategy report are shown below, detailing the maintenance of each feature within the drainage network.

## 9.1 Filter Drains

Table 9.1 demonstrations the minimum maintenance regime which should be undertaken for filter drains.

Table 9.1 - Details of filter drains maintenance

| • **Maintenance schedule** | • **Required Action** | • **Frequency** |
|---|---|---|
| • Regular Maintenance | • Litter and debris removal. | • Monthly |
| | • Manage other vegetation and remove nuisance plants | • Monthly at start then as required |
| • Occasional Maintenance | • Check for areas of poor infiltration due to sediment | • Annually |
| | • Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions if required. | • Annually |
| • Remedial Actions | • Repair erosion or other damage by re-turfing or re-seeding. | • As required |
| | • Re-level uneven surfaces and reinstate design levels. | • As required |
| | • Remove and dispose of oils or petrol residues using safe standard practices. | • As required |
| • Monitoring | • Inspect drain surface for areas of vehicle overrun or where stone scatter has occurred | • Half yearly |

## 9.2 Packaged (Industry Standard) Treatment Plants

Treatment tanks must be registered with SEPA prior to their commissioning. The plant should be emptied at 12-month intervals or at the interval period specified by the tank manufacturer. After removal, waste should be treated off site.

## 9.3 Swales / Ditches

Details of the operational and maintenance requirements of the drainage swales are noted in Table 9.2, below.

Table 9.2 - Details of swales / ditch maintenance

| Maintenance schedule | Required Action | Frequency |
|---|---|---|
| Regular Maintenance | Litter and debris removal. | Monthly |
| | Grass cutting. | Monthly during growing season |
| | Manage other vegetation and remove nuisance plants | Monthly at start then as required |
| Occasional Maintenance | Check for areas of poor vegetation growth due to lack of sunlight or dropping of leaf litter and cut back adjacent vegetation where possible. | Annually |
| | Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions if required. | Annually |
| Remedial Actions | Repair erosion or other damage by re-turfing or re-seeding. | As required |
| | Re-level uneven surfaces and reinstate design levels. | As required |
| | Remove and dispose of oils or petrol residues using safe standard practices. | As required |
| Monitoring | Inspect drain surface for areas of vehicle overrun or where the topsoil has become compacted. | Half yearly |

## 9.4 Detention Basins

Details of the operational and maintenance requirements of the detention basins are noted in Table 9.3, below.

Table 9.3 – Details of detention basins maintenance

| Maintenance Schedule | Required Action | Frequency |
|---|---|---|
| Regular Maintenance | Litter and debris removal | Monthly. |
| | Grass cutting - for spillways and access routes. | Monthly (during growing season), or as required. |
| | Grass cutting - meadow grass in and around basin. | Half yearly (spring - before nesting season, and autumn). |
| | Manage other vegetation and remove nuisance plants. | Monthly (at start, then as required). |
| | Tidy all dead growth before start of growing season. | Annually. |
| | Remove sediment from inlets, outlet and forebay. | Annually (or as required). |
| | Manage wetland plants in outlet pool - where provided. | Annually. |
| Occasional Maintenance | Re-seed areas of poor vegetation growth. | Annually (or as required). |
| | Prune and trim trees and remove cuttings. | 2 Years (or as required). |
| | Remove sediment from forebay, when 50% full and from micropools if volume reduced by > 25%. | 3-10 Years (or as required). |
| Remedial Actions | Repair of erosion or other damage by re-seeding or re-turfing. | As required. |
| | Realignment of rip-rap. | As required. |
| | Repair / rehabilitation of inlets, outlets and overflows. | As required. |
| | Re-level uneven surfaces and reinstate design levels. | As required. |
| Monitoring | Inspect inlets, outlets and overflows for blockages, and clear if required. | Monthly / After large storms |
| | Inspect banksides, structures, pipework etc for evidence of physical damage. | Monthly / After large storms |

| • **Maintenance Schedule** | • **Required Action** | • **Frequency** |
|---|---|---|
| | • Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies. | • Half yearly |
| | • Check penstocks and other mechanical devices. | • Half yearly |

# 10 Conclusions

The DIA is required to document how all drainage associated with the site will be dealt with. The design discharge rates from the SuDS are lower than the IH124 greenfield runoff rates, meaning that the impact on flood risk to the existing watercourses is not increased. As discussed in the body of the report, reduced run-off rates have been promoted due to the informal nature of the receiving drainage features and downstream receptors in private homeowners and fishing ponds.

This report concludes that there is no significant flood risk to the surrounding areas, as the design discharge rates of the SuDS network are limited to discharge rates far less than the pre-development greenfield run-off rates during peak rainfall events which would cause flooding. Exceedance is accounted for, and all basins will be flow controlled to ensure that they are not overwhelmed by excess water flow. The foul water produced on site is directed into two packaged treatment plants sizes of which are still to be provided by SSEN. Groundwater will be controlled via cut-off drains and toe-drains, preventing flooding from any surface water or excess surface water from embankments. Construction of the drainage network will be overseen by SSEN. All parts of the network will be kept separate, eliminating the possibility of cross-contamination from foul water assets.

Maintenance, both long term and short term, will be overseen by SSEN. This still requires formal confirmation. They will take full responsibility for the network post-design.

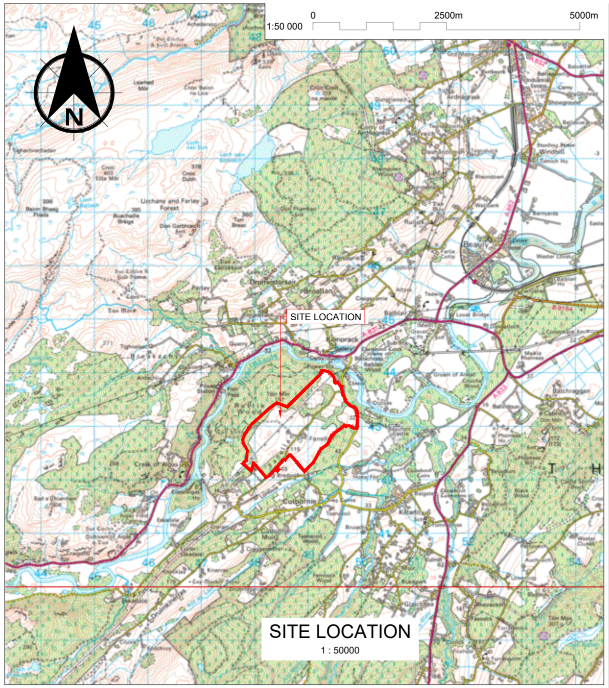
# Appendix A

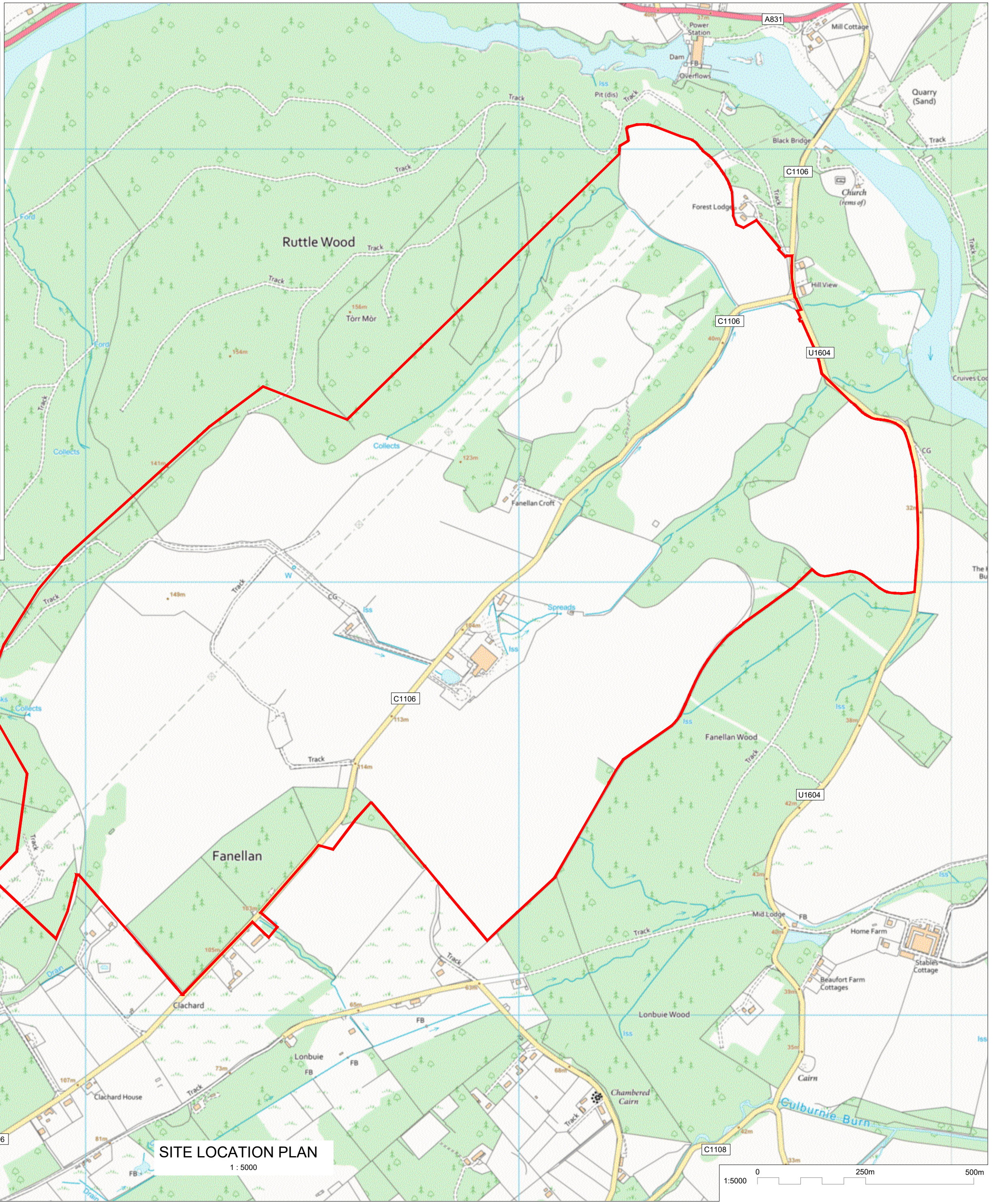
## Site Layout Drawings

LT459-SWE-XX-XX-D-X-0001

LT459-SWE-XX-XX-D-X-0002

LT459-SWE-XX-XX-D-X-0003




## NOTES

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3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. REFER TO DRAWINGS LT459-SWE-XX-D-X-0002 AND LT459-SWE-XX-D-X-0003 FOR FURTHER DETAILS OF THE SITE LAYOUT.

KEY TO DRAWING

- PLANNING RED LINE BOUNDARY (223 HA)
- CONIFEROUS TREES
- NON-CONIFEROUS TREES
- BRAKEN, HEATH OR ROUGH GRASSLAND
- WATER
- BUILDINGS
- BOUNDARY WALL OR FENCE
- Iss — ISSUES
- o W — WELL
- 32m — EXISTING GROUND LEVEL
- 400kV OVERHEAD LINE AND TOWER
- EXISTING TRACK
- Collects — WATERCOURSE FORMATION
- C CLASS OR UNCLASSIFIED ROAD
- A CLASS ROAD

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P09 | 28/11/2024 | LEGEND ADDED | RL | NG | CB |
| P08 | 08/08/2024 | TITLE UPDATED | RL | NG | CB |
| P07 | 30/04/2024 | BOUNDARY UPDATED | RL | NG | CB |
| P06 | 19/04/2024 | DESIGN FIX 2C | RL | NG | CB |
| P05 | 30/01/2024 | PAN BOUNDARY UPDATED | RL | NG | CB |
| P04 | 19/01/2024 | PAN BOUNDARY UPDATED | RL | NG | CB |
| P03 | 15/12/2023 | DESIGN FIX A | MA | RL | CB |
| P02 | 15/11/2023 | RLB INCREASED | MA | RL | CB |
| P01 | 10/10/2023 | FOR COMMENT | MA | RL | CB |

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SWECO

Client

Scottish & Southern Electricity Networks
TRANSMISSION

Project Title

FANELLAN
400kV SWITCHING STATION AND
HVDC CONVERTOR STATION

Drawing Title

SITE LOCATION PLAN
SHEET 1 OF 1

Purpose Of Issue

PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| **Drawn** | **Designed** | **Checked** | **Approved** |
| MA | RL | RL | CB |
| **Sheet Size** | **Scale** | **Sweco Ref** | **Revision** |
| A1 | AS SHOWN | 65209842 | P09 |

Drawing Number

LT459-SWE-XX-XX-D-X-0001

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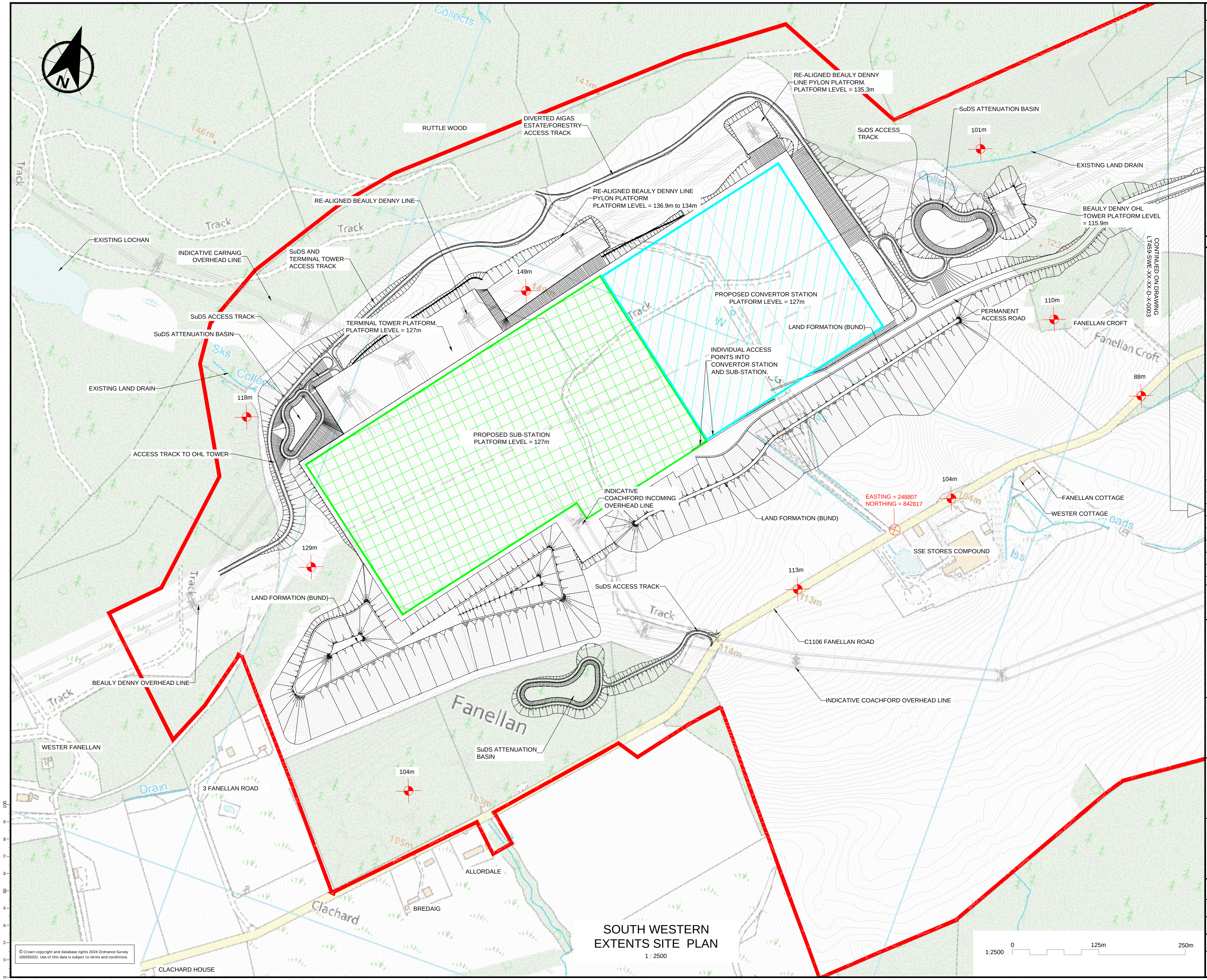


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3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. REFER TO DRAWING LT459-SWE-XX-XX-D-X-0001 FOR DETAILS OF THE SITE LOCATION.
5. REFER TO DRAWING LT459-SWE-XX-XX-D-X-0003 FOR DETAILS OF THE NORTH EASTERN EXTENTS OF THE SITE.
6. PROPOSED AND EXISTING TOPOGRAPHY CONTOURS ARE SHOWN AT 1m INTERVALS OF HEIGHT DIFFERENCE.

KEY TO DRAWING

- PLANNING BOUNDARY AREA = 223 Ha
- 100m EXISTING TOPOGRAPHY SPOT LEVEL
- CONVERTOR STATION AREA
- SUB-STATION AREA

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P08 | 28/01/2025 | ROAD ALIGNMENTS UPDATED | RL | NG | CB |
| P07 | 28/11/2024 | CONTOURS ADDED | RL | NG | CB |
| P06 | 20/08/2024 | FINAL LAYOUT | RL | NG | CB |
| P05 | 14/06/2024 | COMMENTS ADDRESSED | RL | NG | CB |
| P04 | 18/04/2024 | DESIGN FIX 2C | RL | NG | CB |
| P03 | 29/02/2024 | DESIGN FIX 2B | RL | NG | CB |
| P02 | 15/12/2023 | DESIGN FIX A | MA | RL | CB |
| P01 | 10/10/2023 | FOR COMMENT | MA | RL | CB |

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Client

Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

SITE PLAN
SHEET 1 OF 2

Purpose Of Issue

PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| Drawn | Designed | Checked | Approved |
| NG | NG | | |
| Sheet Size | Scale | Sweco Ref | Revision |
| A1 | 1:2500 | 65209842 | P08 |

Drawing Number

LT459-SWE-XX-XX-D-X-0002

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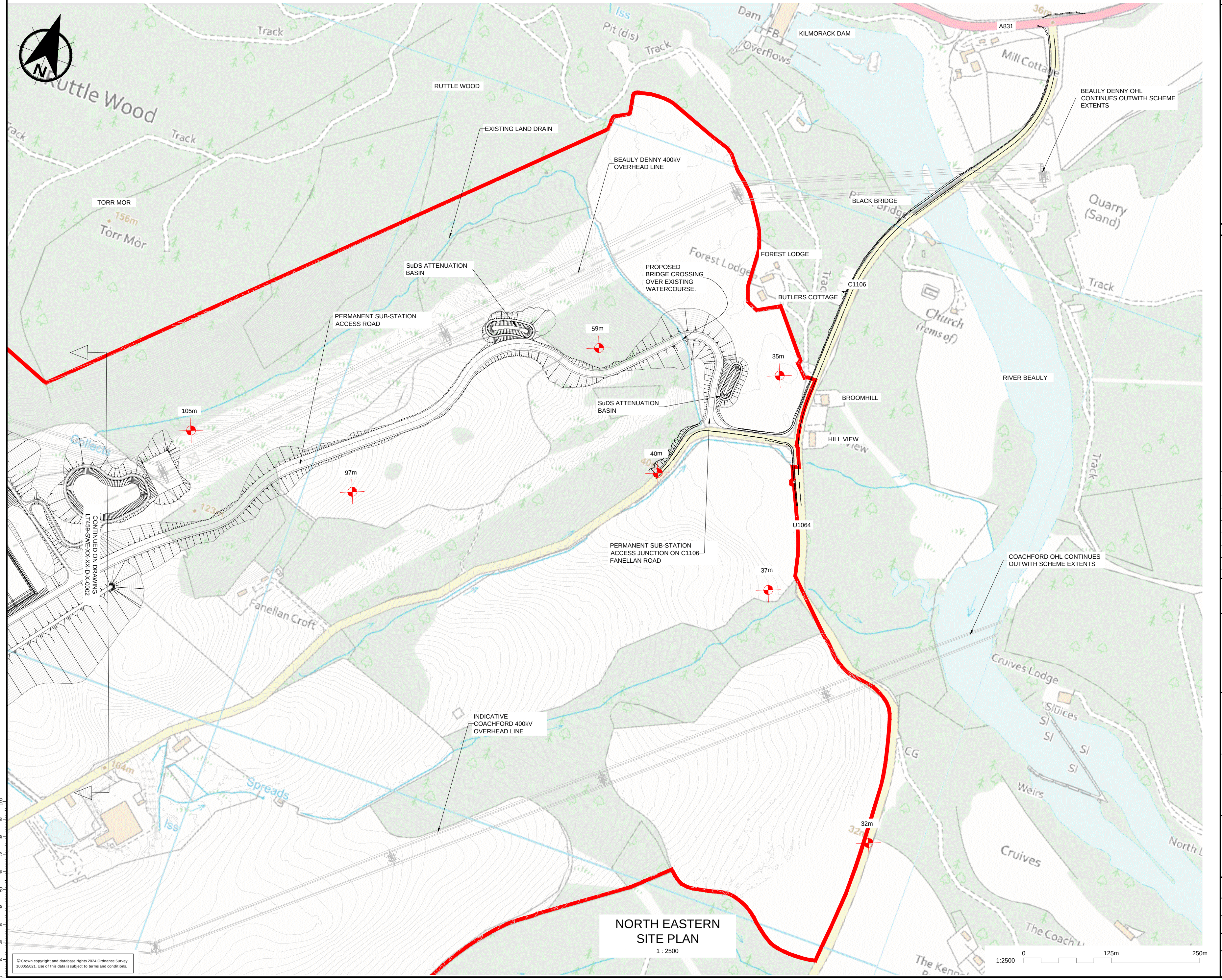


P:\6551\65209842_Beauly_Hub\000\D-Z-0000_Drawings\Site Layout Drawings\AutoCAD\0000 - Location Plans\ LT459-SWE-XX-XX-D-X-0003_P08 Detail Removed.dwg

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4. REFER TO DRAWING LT459-SWE-XX-XX-D-X-0001 FOR DETAILS OF THE SITE LOCATION.
5. REFER TO DRAWING LT459-SWE-XX-XX-D-X-0002 FOR DETAILS OF THE SOUTH WESTERN EXTENTS OF THE SITE.
6. PROPOSED AND EXISTING TOPOGRAPHY CONTOURS ARE SHOWN AT 1m INTERVALS OF HEIGHT DIFFERENCE.

KEY TO DRAWING

PLANNING BOUNDARY AREA = 223 Ha

100m EXISTING TOPOGRAPHY SPOT LEVEL

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P08 | 10/02/2025 | ACCESS ROAD AMENDED | RL | NG | CB |
| P07 | 28/11/2024 | CONTOURS ADDED | RL | NG | CB |
| P06 | 20/08/2024 | FINAL LAYOUT | RL | NG | CB |
| P05 | 14/06/2024 | COMMENTS ADDRESSED | RL | NG | CB |
| P04 | 18/04/2024 | DESIGN FIX 2C | RL | NG | CB |
| P03 | 29/02/2024 | DESIGN FIX 2B | RL | NG | CB |
| P02 | 15/12/2023 | DESIGN FIX A | MA | RL | CB |
| P01 | 10/10/2023 | FOR COMMENT | MA | RL | CB |

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TRANSMISSION

Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

SITE LAYOUT
SHEET 2 OF 2

Purpose Of Issue

PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| **Drawn** | **Designed** | **Checked** | **Approved** |
| RL | NG | NG | CB |
| **Sheet Size** | **Scale** | **Sweco Ref** | **Revision** |
| A1 | 1:2500 | 65209842 | P08 |

Drawing Number

LT459-SWE-XX-XX-D-X-0003

# Appendix B

## Drainage Drawings

LT459-SWE-XX-XX-D-X-0501
LT459-SWE-XX-XX-D-X-0502
LT459-SWE-XX-XX-D-X-0503
LT459-SWE-XX-XX-D-X-0504
LT459-SWE-XX-XX-D-X-0505
LT459-SWE-XX-XX-D-X-0506
LT459-SWE-XX-XX-D-X-0507
LT459-SWE-XX-XX-D-X-0508
LT459-SWE-XX-XX-D-X-0509
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LT459-SWE-XX-XX-D-X-0511
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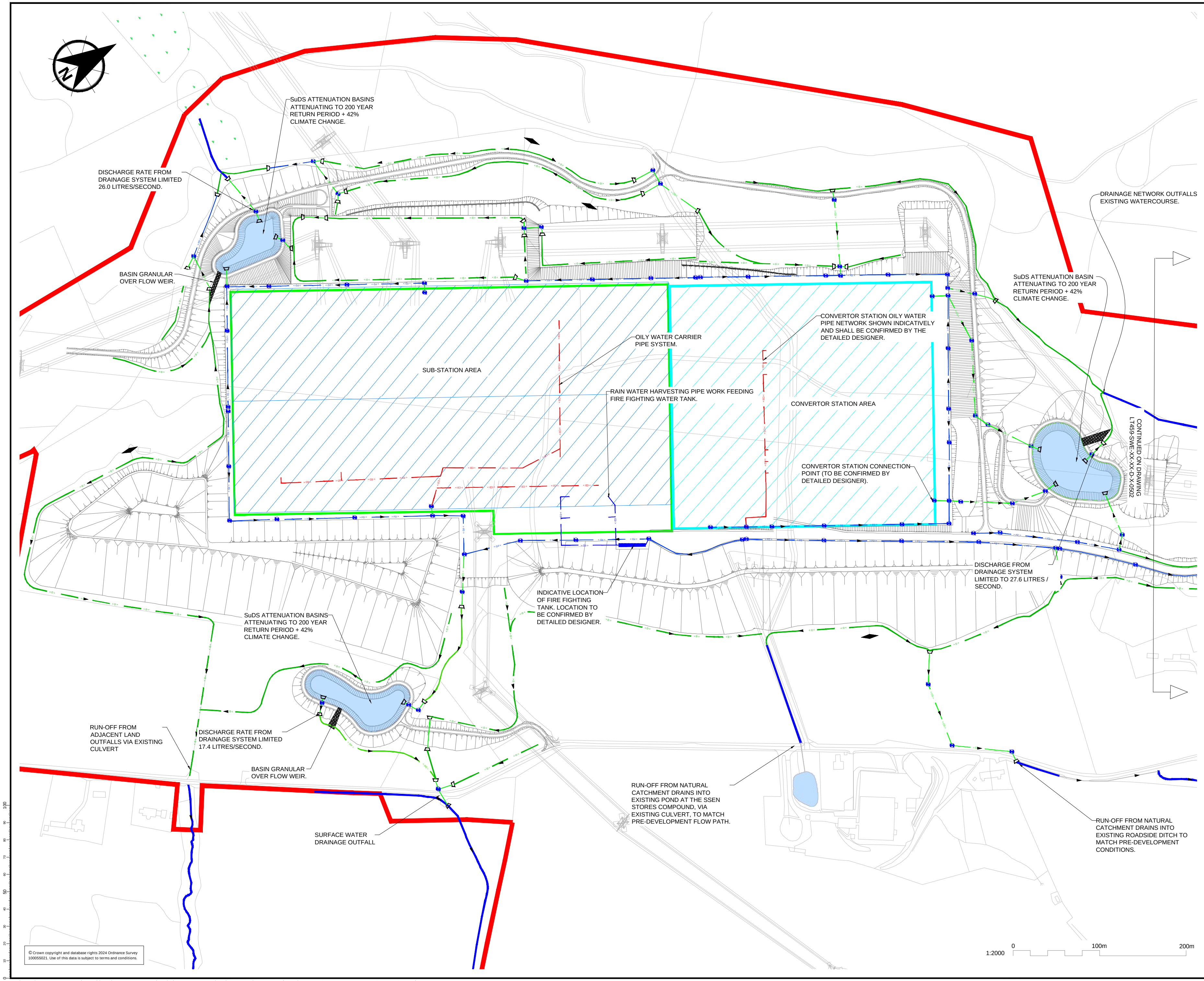


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4. REFER TO DRAWING LT459-SWE-XX-XX-D-X-0502 FOR DETAILS OF THE NORTH EASTERN EXTENTS OF THE SITE.
5. FOR THE DETAILED LAYOUT OF THE DRAINAGE NETWORKS, REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0507, LT459-SWE-XX-XX-D-X-0508, LT459-SWE-XX-XX-D-X-0509 AND LT459-SWE-XX-XX-D-X-0510.
6. FOR THE TYPICAL DRAINAGE DETAILS PROPOSED, REFER TO DRAWING LT459-SWE-XX-XX-D-X-0503.
7. THE OILY WATER STRATEGY FOR THE CONVERTOR STATION SHALL BE CONFIRMED BY THE DETAILS DESIGNER.
8. ALL SUDS BASINS INCORPORATE LIFE BUOY RINGS AT EACH INLET HEADWALL.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- FILTER DRAIN
- CARRIER DRAIN
- DRAINAGE SWALE
- CUT-OFF DITCH
- ROUTE OF EXISTING DRAINAGE FEATURE
- OILY WATER CARRIER DRAIN
- RAINWATER HARVESTING WATER CARRIER DRAIN
- DRAINAGE CHAMBER
- HEADWALL
- TRAPPED GULLY
- FLOW DIRECTION ARROW
- GRANULAR PLATFORM AREA USED FOR ATTENUATION
- BREAK POINT IN DRAINAGE NETWORK
- CONVERTOR STATION AREA
- SUB-STATION AREA

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P07 | 28/01/2025 | TOWER ACCESS TRACK ADDED | RL | SG | CB |
| P06 | 20/08/2024 | LAYOUT UPDATED | RL | SG | CB |
| P05 | 20/06/2024 | LAYOUT UPDATES | RL | SG | CB |
| P04 | 18/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P03 | 18/03/2024 | HVAC (W) MINOR LAYOUT CHANGE | RL | SG | CB |
| P02 | 06/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |


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Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

SURFACE WATER DRAINAGE OVERVIEW
SHEET 1 OF 2

Purpose Of Issue

PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| Drawn | Designed | Checked | Approved |
| RL | RL | SG | CB |
| Sheet Size | Scale | Sweco Ref | Revision |
| A1 | 1:2000 | 65209842 | P07 |

Drawing Number

LT459-SWE-XX-XX-D-X-0501

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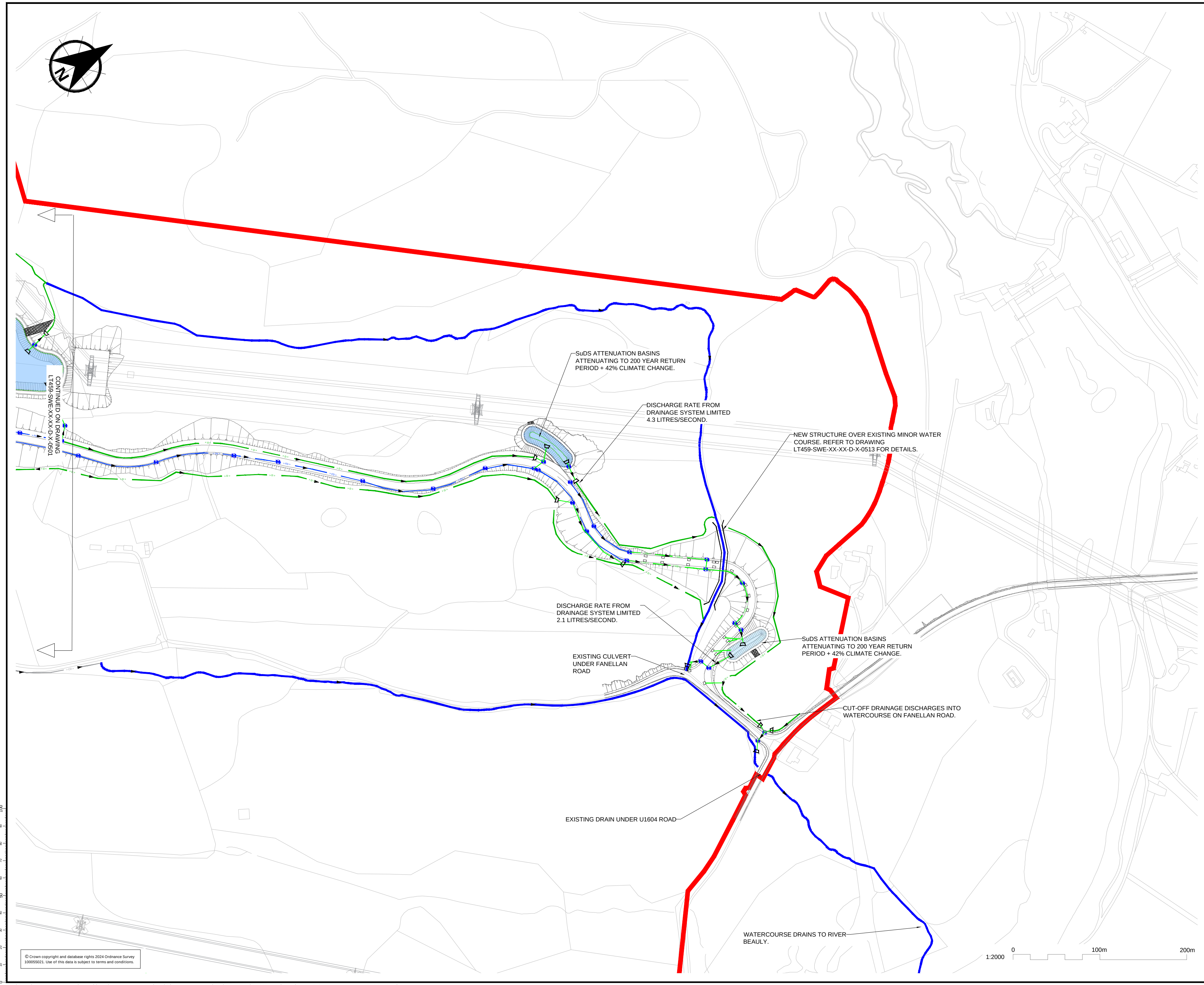


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4. REFER TO DRAWING LT459-SWE-XX-XX-D-X-0501 FOR DETAILS OF THE SOUTH WESTERN EXTENTS OF THE SITE.
4. FOR THE DETAILED LAYOUT OF THE DRAINAGE NETWORKS, REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0507, LT459-SWE-XX-XX-D-X-0508, LT459-SWE-XX-XX-D-X-0509 AND LT459-SWE-XX-XX-D-X-0510.
5. FOR THE TYPICAL DRAINAGE DETAILS PROPOSED, REFER TO DRAWING LT459-SWE-XX-XX-D-X-0503.

## KEY TO DRAWING

- SITE RED LINE BOUNDARY
- FILTER DRAIN
- CARRIER DRAIN
- DRAINAGE SWALE
- CUT-OFF DITCH
- ROUTE OF EXISTING DRAINAGE FEATURE
- DRAINAGE CHAMBER
- HEADWALL
- TRAPPED GULLY
- FLOW DIRECTION ARROW
- GRANULAR PLATFORM AREA USED FOR ATTENUATION
- BREAK POINT IN DRAINAGE NETWORK

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P05 | 28/01/2025 | ACCESS ROAD UPDATED | RL | SG | CB |
| P04 | 20/08/2024 | LAYOUT UPDATED | RL | SG | CB |
| P03 | 18/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P02 | 06/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

SURFACE WATER DRAINAGE OVERVIEW
SHEET 2 OF 2

Purpose Of Issue

PRELIMINARY

| Status | Status Description |
|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE |

| Drawn | Designed | Checked | Approved |
|---|---|---|---|
| RL | RL | SG | CB |

| Sheet Size | Scale | Sweco Ref | Revision |
|---|---|---|---|
| A1 | 1:2000 | 65209842 | P05 |

Drawing Number

LT459-SWE-XX-XX-D-X-0502

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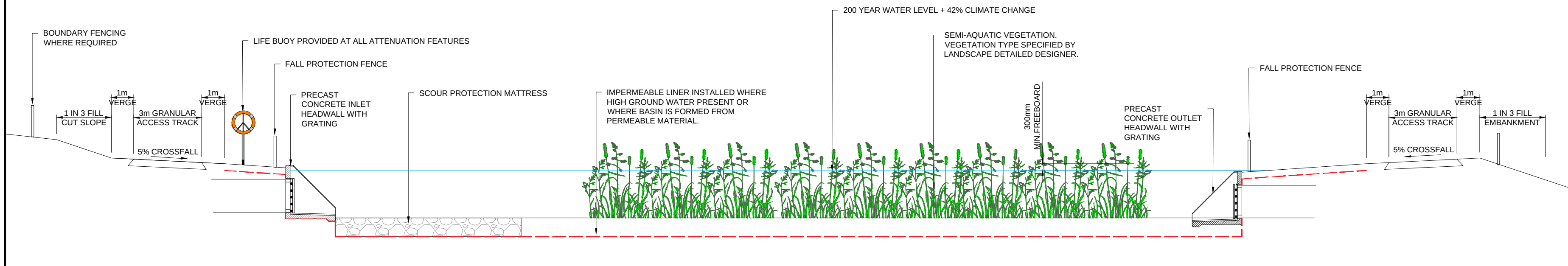
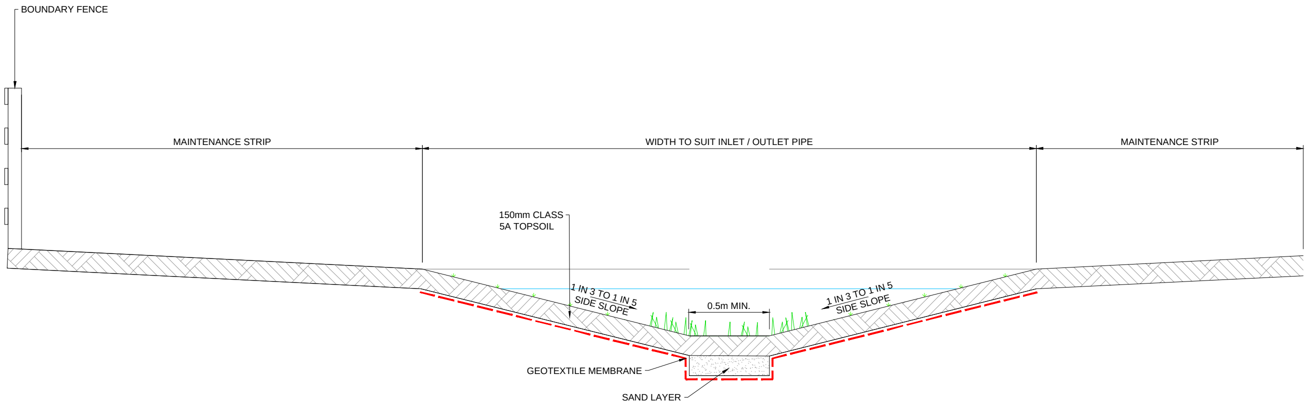
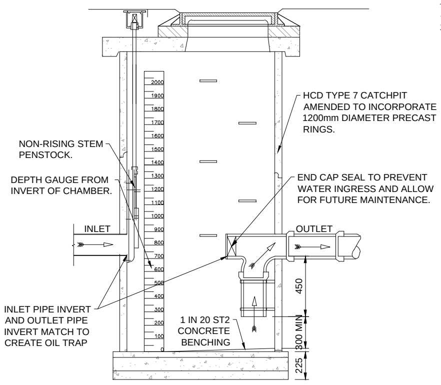


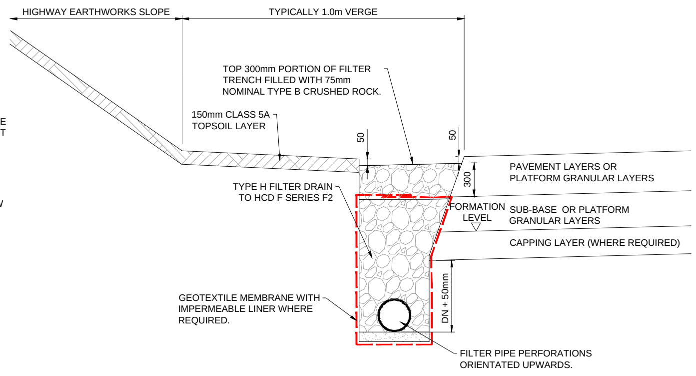

TYPICAL SuDS ATTENUATION AND TREATMENT BASIN
SCALE 1:100



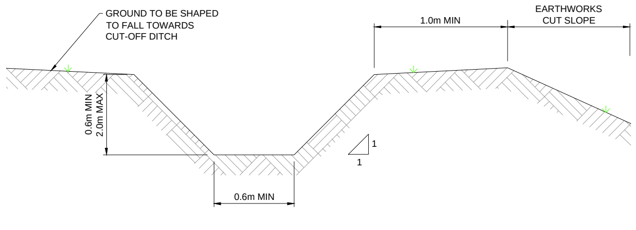

TYPICAL WET SWALE
SCALE 1:20m




TYPICAL POLLUTION CONTROL
CHAMBER
SCALE 1:20




TYPICAL FILTER DRAIN
SCALE 1:20




TYPICAL CUT-OFF/PRE-EARTHWORKS DITCH
SCALE 1:20m

# NOTES

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. ALL SLOPES AND EMBANKMENTS SHOWN ON THIS DRAWING FALL OR RISE AT 1 IN 3 UNLESS OTHERWISE NOTED ON THE SPECIFIC DETAIL.
5. REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0501 AND LT459-SWE-XX-XX-D-X-0502 FOR THE DRAINAGE LAYOUT.

KEY TO DRAWING

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P04 | 20/08/2024 | FINAL ISSUE | RL | SG | CB |
| P03 | 18/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P02 | 05/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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SWECO

Client
Scottish & Southern Electricity Networks
TRANSMISSION

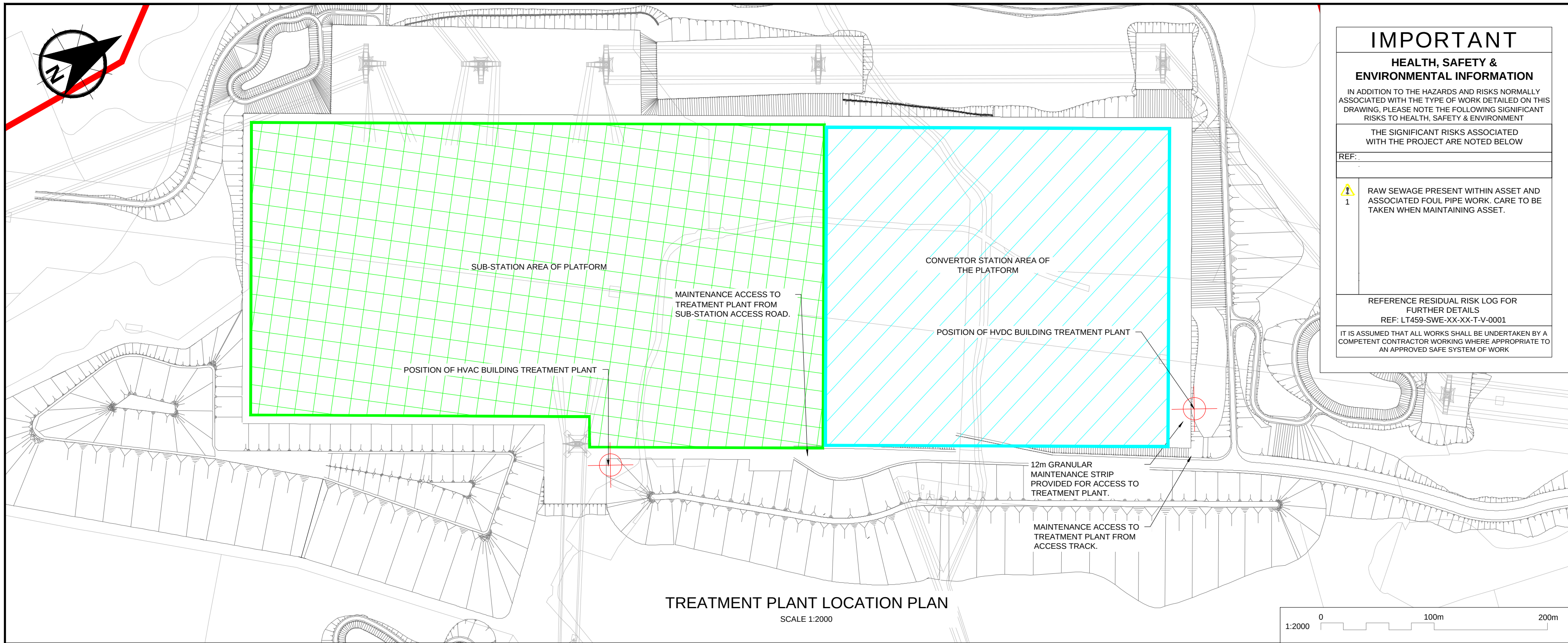
Project Title
FANELLAN
400kV SWITCHING STATION AND
HVDC CONVERTOR STATION

Drawing Title
TYPICAL DRAINAGE DETAILS
SHEET 1 OF 1

Purpose Of Issue
PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| Drawn | Designed | Checked | Approved |
| RL | RL | SG | CB |
| Sheet Size | Scale | Sweco Ref | Revision |
| A1 | AS SHOWN | 65209842 | P04 |

Drawing Number
LT459-SWE-XX-XX-D-X-0503




## IMPORTANT

**HEALTH, SAFETY & ENVIRONMENTAL INFORMATION**

IN ADDITION TO THE HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING SIGNIFICANT RISKS TO HEALTH, SAFETY & ENVIRONMENT

THE SIGNIFICANT RISKS ASSOCIATED WITH THE PROJECT ARE NOTED BELOW

REF:

1 — RAW SEWAGE PRESENT WITHIN ASSET AND ASSOCIATED FOUL PIPE WORK. CARE TO BE TAKEN WHEN MAINTAINING ASSET.

REFERENCE RESIDUAL RISK LOG FOR FURTHER DETAILS
REF: LT459-SWE-XX-XX-T-V-0001

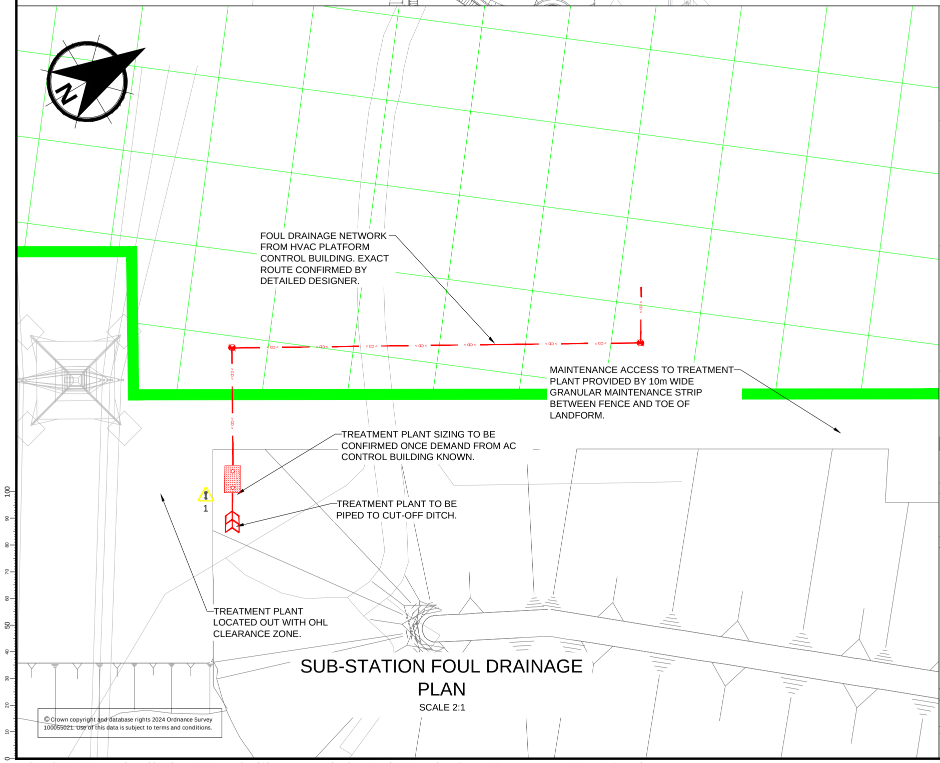
IT IS ASSUMED THAT ALL WORKS SHALL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING WHERE APPROPRIATE TO AN APPROVED SAFE SYSTEM OF WORK

## NOTES

1. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. ALL TREATMENT PLANTS ARE LOCATED A MINIMUM OF 7M FROM ANY BUILDINGS.
4. FOR DETAILS OF THE DRINKING WATER SUPPLY, REFER TO DRAWING LT459-SWE-XX-XX-D-X-0505.
5. ALL TREATMENT PLATS SHALL DISCHARGE VIA AN APPROPRIATELY SIZED HERRINGBONE DRAINAGE FIELD.
6. THE LOCATIONS OF THE PACKAGE TREATMENT PLANTS ARE SHOWN INDICATIVELY AND SUBJECT TO DEVELOPMENT DURING THE DETAILED DESIGN PHASE.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- TREATMENT PLANT LOCATION
- FOUL CARRIER DRAIN
- FOUL MANHOLE
- TREATMENT PLANT AND HERRINGBONE DRAINAGE FIELD
- CONVERTOR STATION AREA
- SUB-STATION AREA




SUB-STATION FOUL DRAINAGE PLAN
SCALE 2:1

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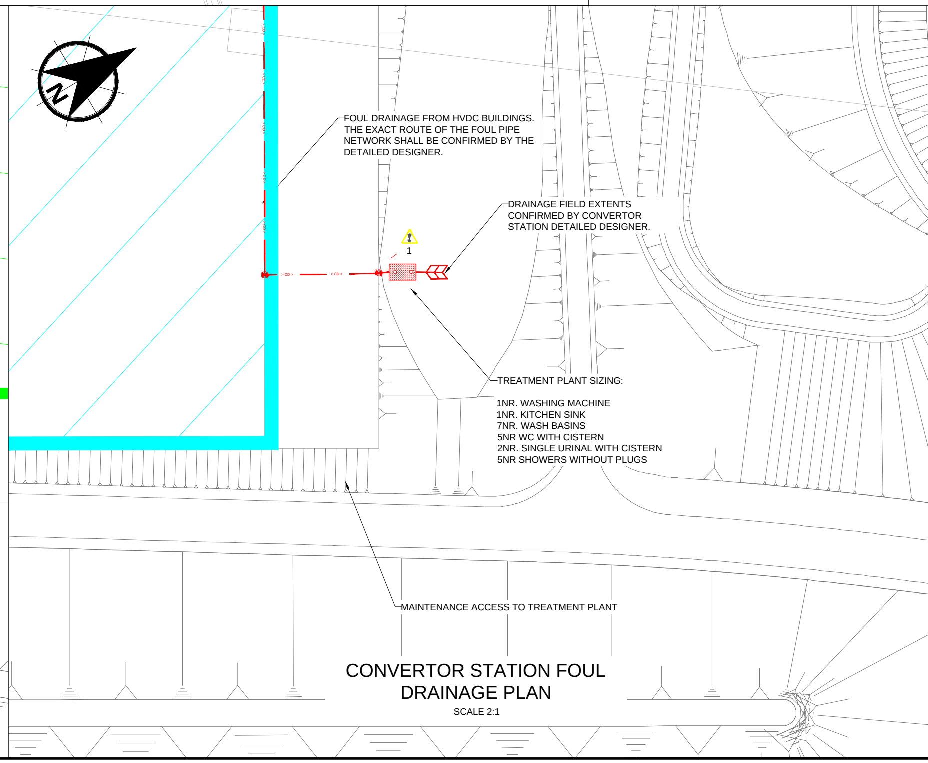


CONVERTOR STATION FOUL DRAINAGE PLAN
SCALE 2:1

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P06 | 28/01/2025 | ACCESS ROADS UPDATED | RL | SG | CB |
| P05 | 20/08/2024 | FINAL ISSUE | RL | SG | CB |
| P04 | 18/06/2024 | LAYOUT UPDATED | RL | SG | CB |
| P03 | 19/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P02 | 05/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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SWECO

Client
Scottish & Southern Electricity Networks
TRANSMISSION

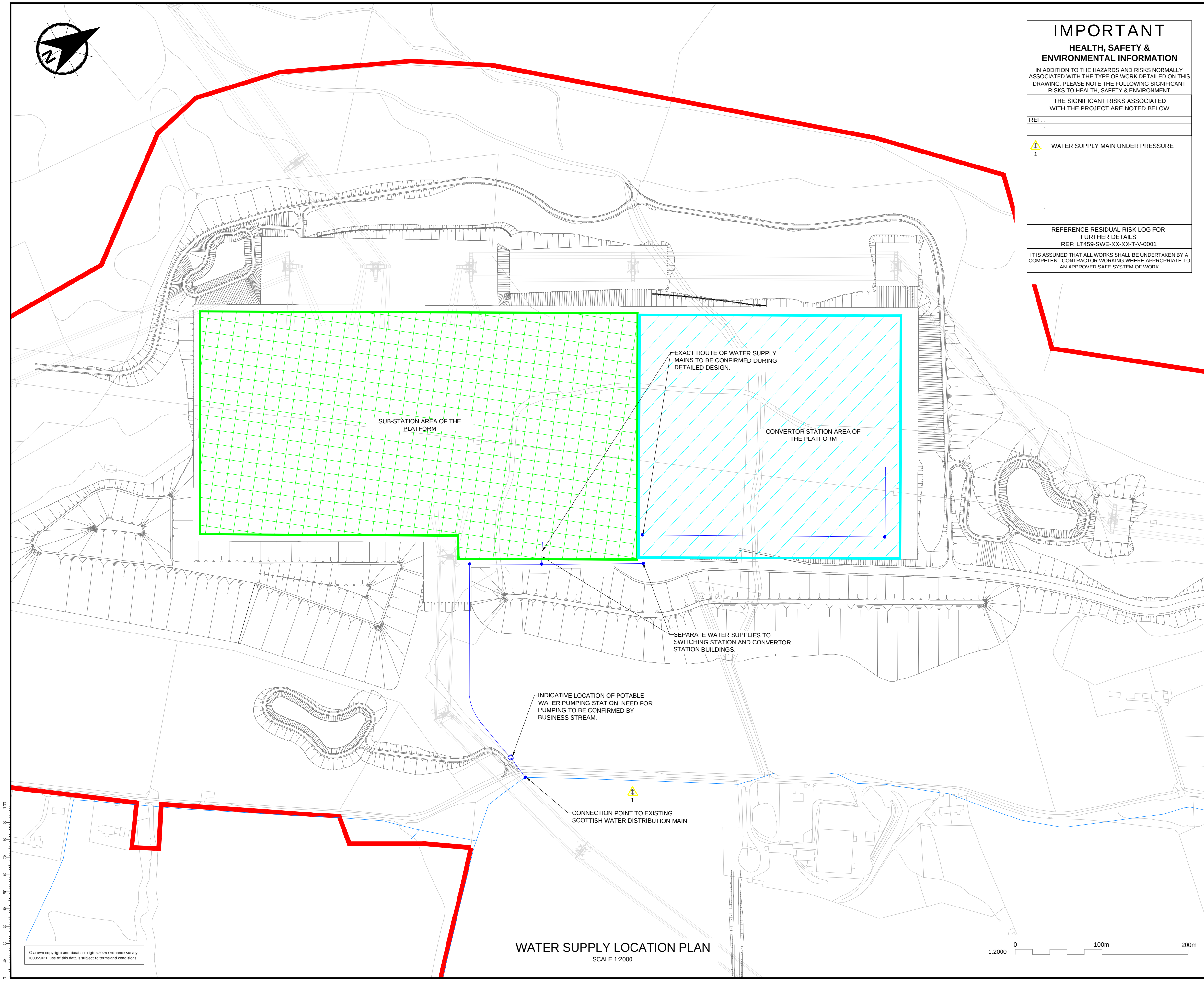
Project Title
FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title
FOUL WATER DRAINAGE LAYOUT
SHEET 1 OF 1

Purpose Of Issue
PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| Drawn | Designed | Checked | Approved |
| RL | RL | SG | CB |
| Sheet Size | Scale | Sweco Ref | Revision |
| A1 | As Shown | 65209842 | P06 |

Drawing Number
LT459-SWE-XX-XX-D-X-0504




WATER SUPPLY LOCATION PLAN

SCALE 1:2000

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## NOTES

1. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. FOR DETAILS OF THE FOUL WATER, REFER TO DRAWING LT459-SWE-XX-XX-D-X-0504.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- NEW SCOTTISH WATER SUPPLY MAIN
- SW — SW EXISTING SCOTTISH WATER DISTRIBUTION MAIN
- CONNECTION POINT / CHAMBER
- INDICATIVE PUMPING STATION
- CONVERTOR STATION AREA
- SUB-STATION AREA

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P06 | 28/01/2025 | ACCESS ROADS UPDATED | RL | SG | CB |
| P05 | 20/08/2024 | FINAL ISSUE | RL | SG | CB |
| P04 | 18/06/2024 | LAYOUT UPDATED | RL | SG | CB |
| P03 | 19/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P02 | 05/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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Client

Scottish & Southern Electricity Networks TRANSMISSION

Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

WATER SUPPLY LAYOUT
SHEET 1 OF 1

Purpose Of Issue

PRELIMINARY

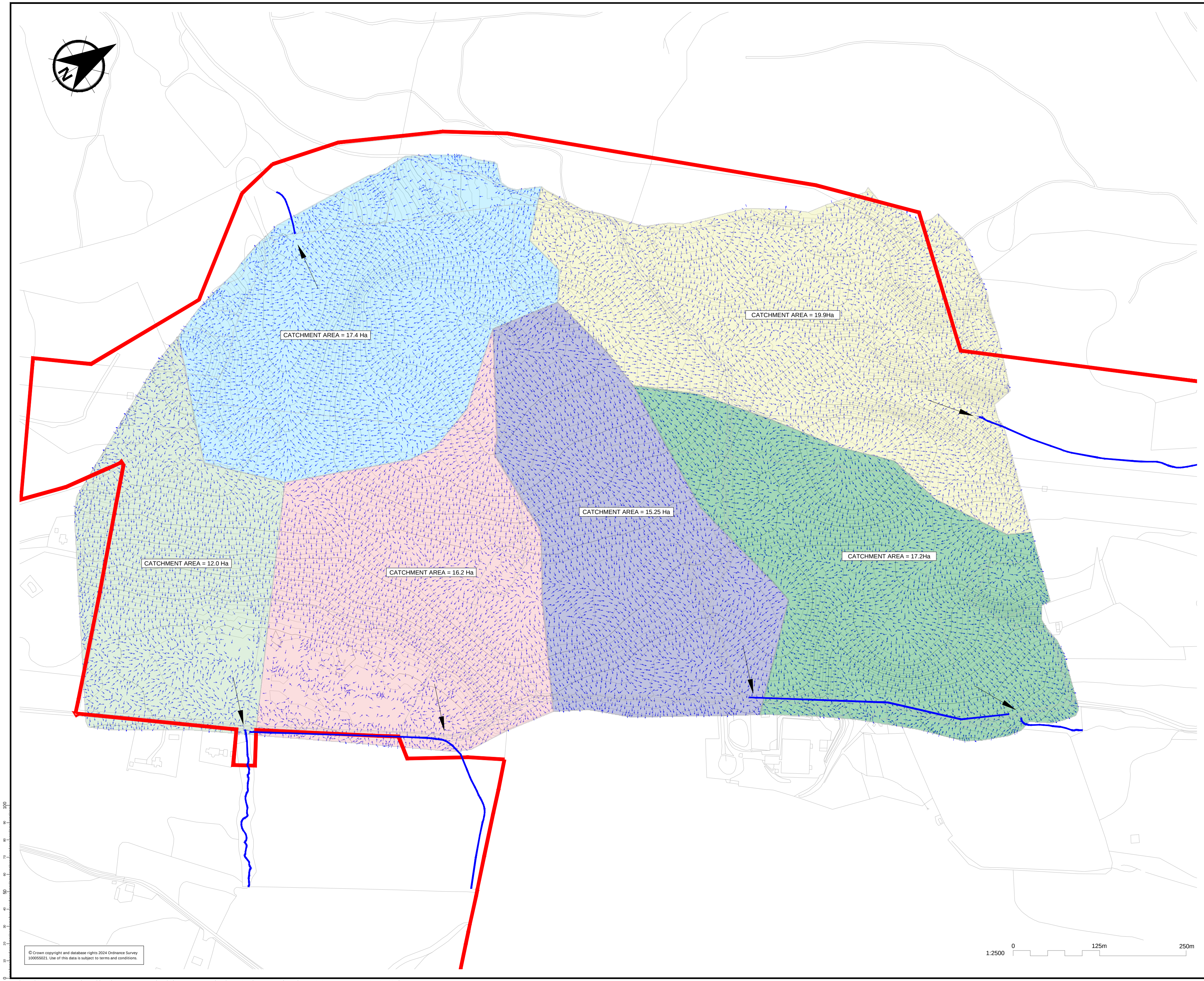
| Status | Status Description |
|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE |

| Drawn | Designed | Checked | Approved |
|---|---|---|---|
| RL | RL | SG | CB |

| Sheet Size | Scale | Sweco Ref | Revision |
|---|---|---|---|
| A1 | 1:2000 | 65209842 | P06 |

Drawing Number

LT459-SWE-XX-XX-D-X-0505




# NOTES

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- EXISTING DRAINAGE FEATURE OR WATERCOURSE
- CATCHMENT DRAIN POINT

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P03 | 20/08/2024 | FINAL ISSUE | RL | SG | CB |
| P02 | 19/04/2024 | DESIGN FIX 2C | MA | RL | CB |
| P01 | 15/12/2023 | DESIGN FIX A | MA | RL | CB |


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Client

Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

EXISTING SURFACE WATER CATCHMENT
SHEET 1 OF 1

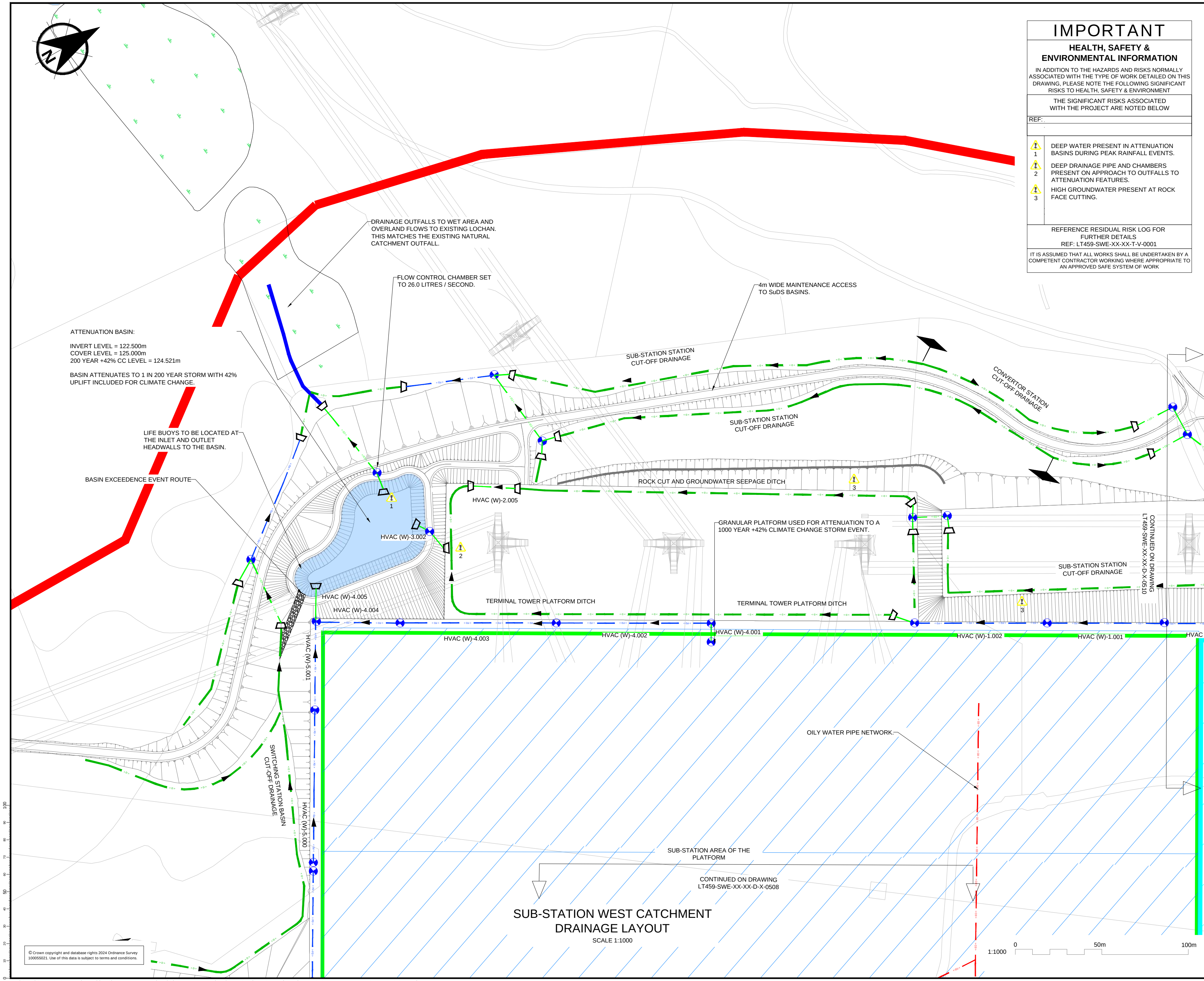
Purpose Of Issue

PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| Drawn | Designed | Checked | Approved |
| MA | RL | RL | CB |
| Sheet Size | Scale | Sweco Ref | Revision |
| A1 | 1:2500 | 65209842 | P03 |

Drawing Number

LT459-SWE-XX-XX-D-X-0506




# IMPORTANT

## HEALTH, SAFETY & ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING SIGNIFICANT RISKS TO HEALTH, SAFETY & ENVIRONMENT

THE SIGNIFICANT RISKS ASSOCIATED WITH THE PROJECT ARE NOTED BELOW

REF:

1. DEEP WATER PRESENT IN ATTENUATION BASINS DURING PEAK RAINFALL EVENTS.
2. DEEP DRAINAGE PIPE AND CHAMBERS PRESENT ON APPROACH TO OUTFALLS TO ATTENUATION FEATURES.
3. HIGH GROUNDWATER PRESENT AT ROCK FACE CUTTING.

REFERENCE RESIDUAL RISK LOG FOR FURTHER DETAILS
REF: LT459-SWE-XX-XX-T-V-0001

IT IS ASSUMED THAT ALL WORKS SHALL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING WHERE APPROPRIATE TO AN APPROVED SAFE SYSTEM OF WORK

# NOTES

1. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. NOT ALL PIPE REFERENCES ARE SHOWN ON THE LAYOUT PLAN FOR CLARITY.
5. REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0508, LT459-SWE-XX-XX-D-X-0509 AND LT459-SWE-XX-XX-D-X-0510 FOR THE DRAINAGE LAYOUT OF THE OTHER AREAS OF THE SUB-STATION AND SURROUNDING LAND.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- FILTER DRAIN
- CARRIER DRAIN
- DRAINAGE SWALE
- CUT-OFF DITCH
- ROUTE OF EXISTING DRAINAGE FEATURE
- OILY WATER CARRIER DRAIN
- RAINWATER HARVESTING WATER CARRIER DRAIN
- DRAINAGE CHAMBER
- HEADWALL
- TRAPPED GULLY
- FLOW DIRECTION ARROW
- GRANULAR PLATFORM AREA USED FOR ATTENUATION
- HVAC (W) - 1.000 — SUB-STATION WEST CATCHMENT PIPE REFERENCE
- BREAK POINT IN DRAINAGE NETWORK
- ATTENUATION EXCEEDANCE ROUTE
- CONVERTOR STATION AREA
- SUB-STATION AREA

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P08 | 28/01/2025 | ACCESS TRACK ADDED | RL | SG | CB |
| P07 | 15/08/2024 | FINAL LAYOUT | RL | SG | CB |
| P06 | 18/06/2024 | LAYOUT UPDATED | RL | SG | CB |
| P05 | 19/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P04 | 18/03/2024 | OUTFALL RATE AMENDED | RL | SG | CB |
| P03 | 06/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P02 | 29/01/2023 | EXCEEDANCE ROUTES ADDED & OUTFALL UPDATED | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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Client
Scottish & Southern Electricity Networks TRANSMISSION

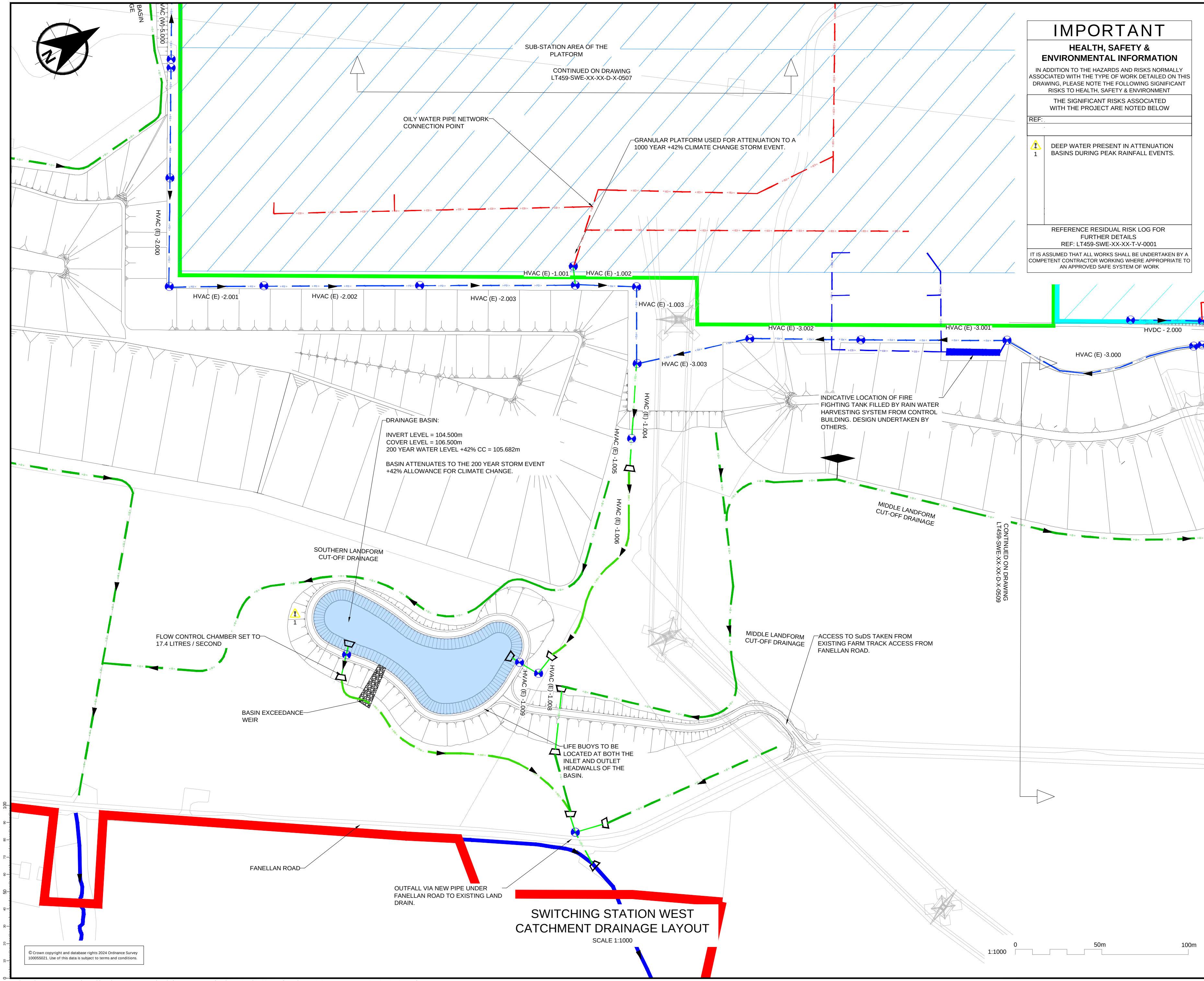
Project Title
FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title
SUB-STATION WESTERN CATCHMENT SURFACE WATER DRAINAGE LAYOUT

Purpose Of Issue
PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| Drawn | Designed | Checked | Approved |
| RL | RL | SG | CB |
| Sheet Size | Scale | Sweco Ref | Revision |
| A1 | 1:1000 | 65209842 | P08 |

Drawing Number
LT459-SWE-XX-XX-D-X-0507




# IMPORTANT

## HEALTH, SAFETY & ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING SIGNIFICANT RISKS TO HEALTH, SAFETY & ENVIRONMENT

THE SIGNIFICANT RISKS ASSOCIATED WITH THE PROJECT ARE NOTED BELOW

REF:

1 DEEP WATER PRESENT IN ATTENUATION BASINS DURING PEAK RAINFALL EVENTS.

REFERENCE RESIDUAL RISK LOG FOR FURTHER DETAILS
REF: LT459-SWE-XX-XX-T-V-0001

IT IS ASSUMED THAT ALL WORKS SHALL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING WHERE APPROPRIATE TO AN APPROVED SAFE SYSTEM OF WORK

# NOTES

1. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. NOT ALL PIPE REFERENCES ARE SHOWN ON THE LAYOUT PLAN FOR CLARITY.
5. REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0507, LT459-SWE-XX-XX-D-X-0509 AND LT459-SWE-XX-XX-D-X-0510 FOR THE DRAINAGE LAYOUT OF THE OTHER AREAS OF THE SUB-STATION AND SURROUNDING LAND.

KEY TO DRAWING

SITE RED LINE BOUNDARY
FILTER DRAIN
CARRIER DRAIN
DRAINAGE SWALE
CUT-OFF DITCH
ROUTE OF EXISTING DRAINAGE FEATURE
OILY WATER CARRIER DRAIN
RAINWATER HARVESTING WATER CARRIER DRAIN
DRAINAGE CHAMBER
HEADWALL
TRAPPED GULLY
FLOW DIRECTION ARROW
GRANULAR PLATFORM AREA USED FOR ATTENUATION
HVAC (E) - 1.000 SUB-STATION WEST CATCHMENT PIPE REFERENCE
BREAK POINT IN DRAINAGE NETWORK
ATTENUATION EXCEEDANCE ROUTE
CONVERTOR STATION AREA
SUB-STATION AREA

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P07 | 10/02/2025 | TOWER PLATFORM REMOVED | RL | SG | CB |
| P06 | 15/08/2024 | FINAL LAYOUT | RL | SG | CB |
| P05 | 18/06/2024 | LAYOUT UPDATED | RL | SG | CB |
| P04 | 19/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P03 | 06/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P02 | 29/01/2023 | EXCEEDANCE ROUTES ADDED | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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SWECO

Client
Scottish & Southern Electricity Networks
TRANSMISSION

Project Title
FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title
SUB-STATION EASTERN CATCHMENT SURFACE WATER DRAINAGE LAYOUT

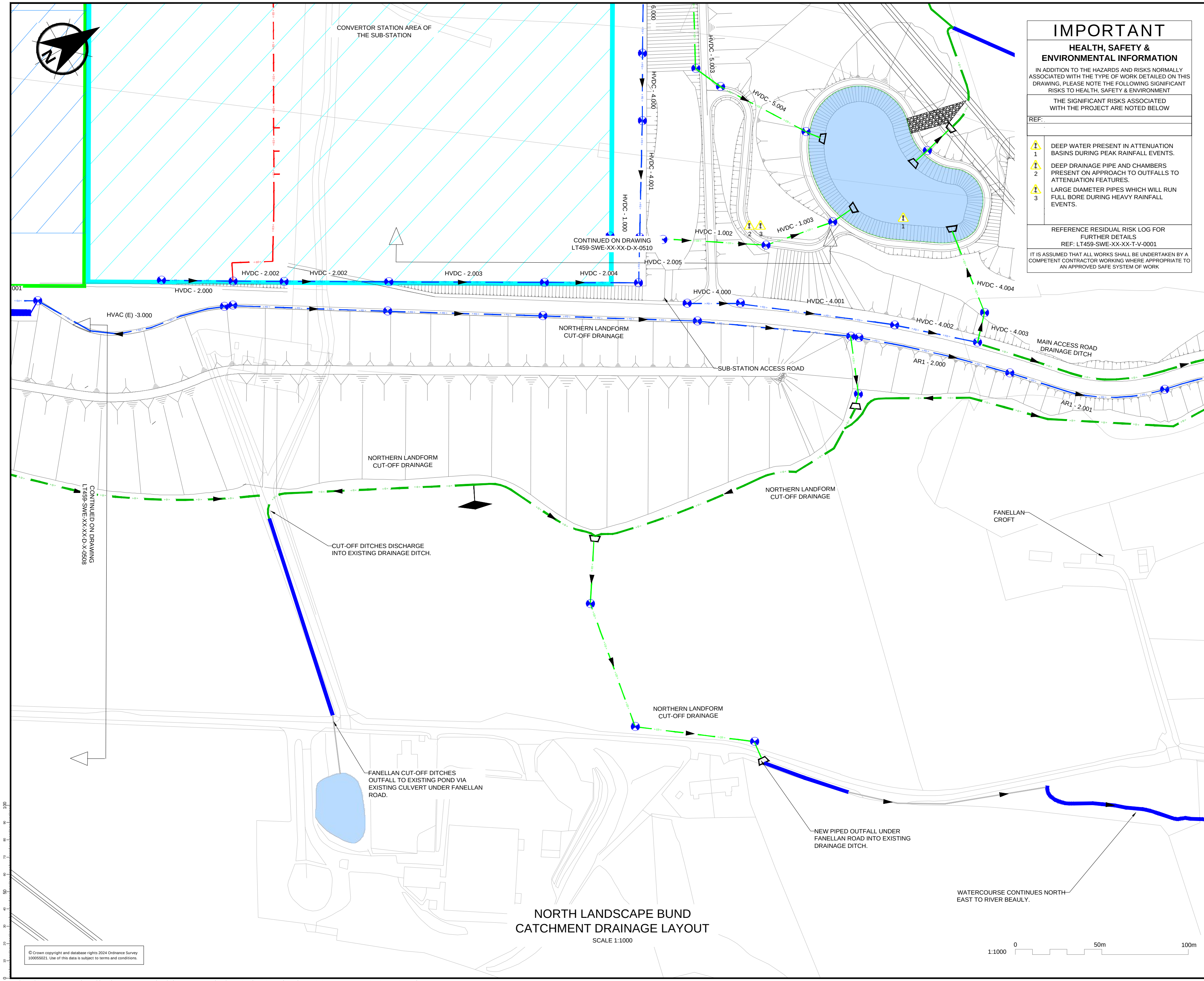
Purpose Of Issue
PRELIMINARY

| Status | Status Description |
|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE |

| Drawn | Designed | Checked | Approved |
|---|---|---|---|
| RL | RL | SG | CB |

| Sheet Size | Scale | Sweco Ref | Revision |
|---|---|---|---|
| A1 | 1:1000 | 65209842 | P07 |

Drawing Number
LT459-SWE-XX-XX-D-X-0508




# NORTH LANDSCAPE BUND
# CATCHMENT DRAINAGE LAYOUT

SCALE 1:1000

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## IMPORTANT

**HEALTH, SAFETY & ENVIRONMENTAL INFORMATION**

IN ADDITION TO THE HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING SIGNIFICANT RISKS TO HEALTH, SAFETY & ENVIRONMENT

THE SIGNIFICANT RISKS ASSOCIATED WITH THE PROJECT ARE NOTED BELOW

REF:

1. DEEP WATER PRESENT IN ATTENUATION BASINS DURING PEAK RAINFALL EVENTS.
2. DEEP DRAINAGE PIPE AND CHAMBERS PRESENT ON APPROACH TO OUTFALLS TO ATTENUATION FEATURES.
3. LARGE DIAMETER PIPES WHICH WILL RUN FULL BORE DURING HEAVY RAINFALL EVENTS.

REFERENCE RESIDUAL RISK LOG FOR FURTHER DETAILS
REF: LT459-SWE-XX-XX-T-V-0001

IT IS ASSUMED THAT ALL WORKS SHALL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING WHERE APPROPRIATE TO AN APPROVED SAFE SYSTEM OF WORK

## NOTES

1. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. NOT ALL PIPE REFERENCES ARE SHOWN ON THE LAYOUT PLAN FOR CLARITY.
5. REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0507, LT459-SWE-XX-XX-D-X-0508 AND LT459-SWE-XX-XX-D-X-0510 FOR THE DRAINAGE LAYOUT OF THE OTHER AREAS OF THE SUB-STATION AND SURROUNDING LAND.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- FILTER DRAIN
- CARRIER DRAIN
- DRAINAGE SWALE
- CUT-OFF DITCH
- ROUTE OF EXISTING DRAINAGE FEATURE
- OILY WATER CARRIER DRAIN
- RAINWATER HARVESTING WATER CARRIER DRAIN
- DRAINAGE CHAMBER
- HEADWALL
- TRAPPED GULLY
- FLOW DIRECTION ARROW
- GRANULAR PLATFORM AREA USED FOR ATTENUATION
- AR - 1.000 — ACCESS ROAD CATCHMENT PIPE REFERENCE
- HVDC - 1.000 — CONVERTOR STATION CATCHMENT PIPE REFERENCE
- BREAK POINT IN DRAINAGE NETWORK
- ATTENUATION EXCEEDANCE ROUTE
- CONVERTOR STATION AREA
- SUB-STATION AREA

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P07 | 28/01/2025 | ACCESS ROAD UPDATD | RL | SG | CB |
| P06 | 20/08/2024 | FINAL LAYOUT | RL | SG | CB |
| P05 | 18/06/2024 | LAYOUT UPDATED | RL | SG | CB |
| P04 | 19/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P03 | 06/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P02 | 29/01/2023 | EXCEEDANCE ROUTES ADDED | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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SWECO

Client

Scottish & Southern Electricity Networks
TRANSMISSION

Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

NORTH LANDSCAPE BUND SURFACE WATER DRAINAGE LAYOUT

Purpose Of Issue

PRELIMINARY

| Status | Status Description |
|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE |

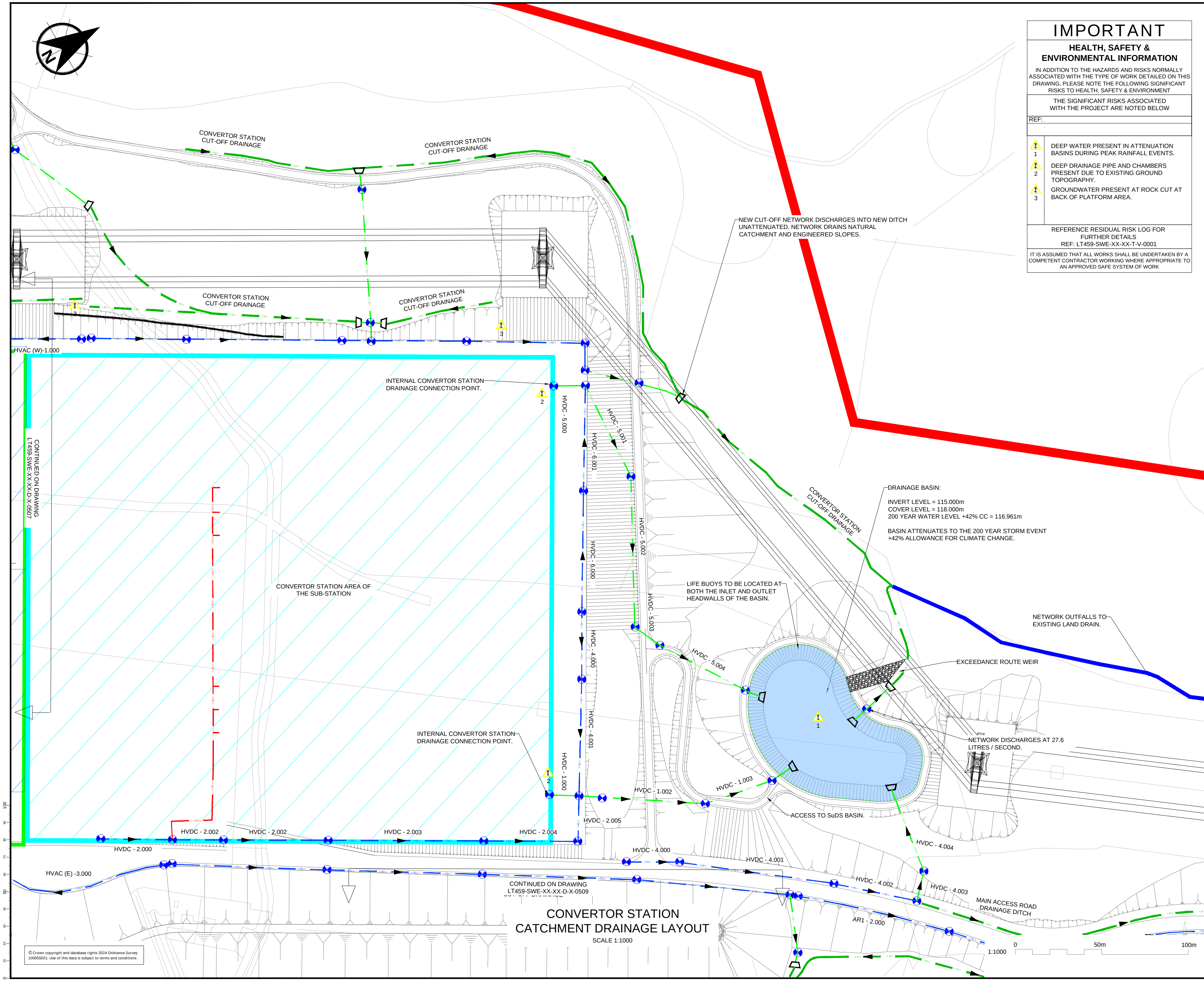
| Drawn | Designed | Checked | Approved |
|---|---|---|---|
| RL | RL | SG | CB |

| Sheet Size | Scale | Sweco Ref | Revision |
|---|---|---|---|
| A1 | 1:1000 | 65209842 | P07 |

Drawing Number

LT459-SWE-XX-XX-D-X-0509

P:\6551\65209842_Beauly_Hub\000\D-Z-0000_Drawings\Site Layout Drawings\AutoCAD\0500 - Drainage\ LT459-SWE-XX-XX-D-X-0509_P07 SIMP.dwg




# IMPORTANT

**HEALTH, SAFETY & ENVIRONMENTAL INFORMATION**

IN ADDITION TO THE HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING SIGNIFICANT RISKS TO HEALTH, SAFETY & ENVIRONMENT

THE SIGNIFICANT RISKS ASSOCIATED WITH THE PROJECT ARE NOTED BELOW

REF:

1. DEEP WATER PRESENT IN ATTENUATION BASINS DURING PEAK RAINFALL EVENTS.
2. DEEP DRAINAGE PIPE AND CHAMBERS PRESENT DUE TO EXISTING GROUND TOPOGRAPHY.
3. GROUNDWATER PRESENT AT ROCK CUT AT BACK OF PLATFORM AREA.

REFERENCE RESIDUAL RISK LOG FOR FURTHER DETAILS
REF: LT459-SWE-XX-XX-T-V-0001

IT IS ASSUMED THAT ALL WORKS SHALL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING WHERE APPROPRIATE TO AN APPROVED SAFE SYSTEM OF WORK

## NOTES

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT PROJECT INFORMATION.
3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. NOT ALL PIPE REFERENCES ARE SHOWN ON THE LAYOUT PLAN FOR CLARITY.
5. REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0507, LT459-SWE-XX-XX-D-X-0508 AND LT459-SWE-XX-XX-D-X-0509 FOR THE DRAINAGE LAYOUT OF THE OTHER AREAS OF THE SUB-STATION AND SURROUNDING LAND.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- FILTER DRAIN
- CARRIER DRAIN
- DRAINAGE SWALE
- CUT-OFF DITCH
- ROUTE OF EXISTING DRAINAGE FEATURE
- OILY WATER CARRIER DRAIN
- RAINWATER HARVESTING WATER CARRIER DRAIN
- DRAINAGE CHAMBER
- HEADWALL
- TRAPPED GULLY
- FLOW DIRECTION ARROW
- GRANULAR PLATFORM AREA USED FOR ATTENUATION
- HVDC - 1.000 CONVERTOR STATION CATCHMENT PIPE REFERENCE
- BREAK POINT IN DRAINAGE NETWORK
- ATTENUATION EXCEEDANCE ROUTE
- CONVERTOR STATION AREA
- SUB-STATION AREA

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P06 | 28/01/2025 | ACCESS ROAD UPDATED | RL | SG | CB |
| P05 | 20/08/2024 | FINAL LAYOUT | RL | SG | CB |
| P04 | 19/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P03 | 06/03/2024 | DESIGN FIX 2B | RL | SG | CB |
| P02 | 29/01/2023 | EXCEEDANCE ROUTES ADDED | RL | SG | CB |
| P01 | 15/12/2023 | DESIGN FIX A | RL | SG | CB |

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SWECO

Client
Scottish & Southern Electricity Networks TRANSMISSION

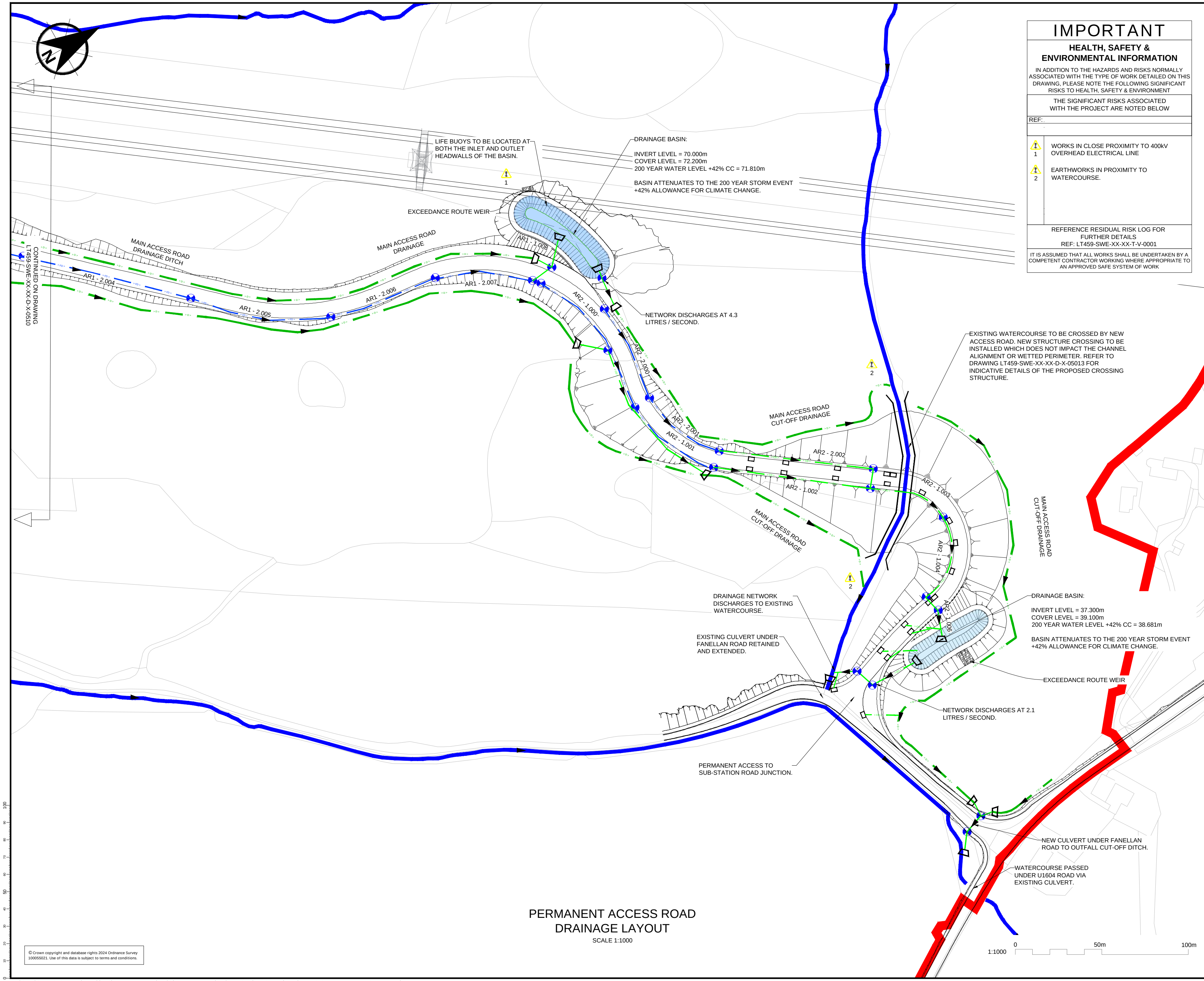
Project Title
FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title
CONVERTOR STATION CATCHMENT SURFACE WATER DRAINAGE LAYOUT

Purpose Of Issue
PRELIMINARY

| Status | Status Description | | |
|---|---|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE | | |
| **Drawn** | **Designed** | **Checked** | **Approved** |
| RL | RL | SG | CB |
| **Sheet Size** | **Scale** | **Sweco Ref** | **Revision** |
| A1 | 1:1000 | 65209842 | P06 |

Drawing Number
LT459-SWE-XX-XX-D-X-0510




# IMPORTANT

## HEALTH, SAFETY & ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING SIGNIFICANT RISKS TO HEALTH, SAFETY & ENVIRONMENT

THE SIGNIFICANT RISKS ASSOCIATED WITH THE PROJECT ARE NOTED BELOW

REF:

1 WORKS IN CLOSE PROXIMITY TO 400kV OVERHEAD ELECTRICAL LINE

2 EARTHWORKS IN PROXIMITY TO WATERCOURSE.

REFERENCE RESIDUAL RISK LOG FOR FURTHER DETAILS
REF: LT459-SWE-XX-XX-T-V-0001

IT IS ASSUMED THAT ALL WORKS SHALL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING WHERE APPROPRIATE TO AN APPROVED SAFE SYSTEM OF WORK

# PERMANENT ACCESS ROAD DRAINAGE LAYOUT

SCALE 1:1000

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5. REFER TO DRAWINGS LT459-SWE-XX-XX-D-X-0507, LT459-SWE-XX-XX-D-X-0508, LT459-SWE-XX-XX-D-X-0509 AND LT459-SWE-XX-XX-D-X-0510 FOR THE DRAINAGE LAYOUT OF THE OTHER AREAS OF THE SUB-STATION AND SURROUNDING LAND.

KEY TO DRAWING

- SITE RED LINE BOUNDARY
- FILTER DRAIN
- CARRIER DRAIN
- DRAINAGE SWALE
- CUT-OFF DITCH
- ROUTE OF EXISTING DRAINAGE FEATURE
- DRAINAGE CHAMBER
- HEADWALL
- TRAPPED GULLY
- FLOW DIRECTION ARROW
- GRANULAR PLATFORM AREA USED FOR ATTENUATION
- BREAK POINT IN DRAINAGE NETWORK
- ATTENUATION EXCEEDANCE ROUTE

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P05 | 28/01/2025 | ACCESS ROAD UPDATED | RL | SG | CB |
| P04 | 20/08/2024 | FINAL LAYOUT | RL | SG | CB |
| P03 | 18/06/2024 | LAYOUT UPDATED | RL | SG | CB |
| P02 | 19/04/2024 | DESIGN FIX 2C | RL | SG | CB |
| P01 | 06/03/2024 | DESIGN FIX 2B | RL | SG | CB |

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SWECO

Client

Scottish & Southern Electricity Networks
TRANSMISSION

Project Title

FANELLAN
400kV SWITCHING STATION AND HVDC CONVERTOR STATION

Drawing Title

PERMANENT ACCESS ROAD SURFACE WATER DRAINAGE LAYOUT

Purpose Of Issue

PRELIMINARY

| Status | Status Description |
|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE |

| Drawn | Designed | Checked | Approved |
|---|---|---|---|
| RL | RL | SG | CB |

| Sheet Size | Scale | Sweco Ref | Revision |
|---|---|---|---|
| A1 | 1:1000 | 65209842 | P05 |

Drawing Number

LT459-SWE-XX-XX-D-X-0511

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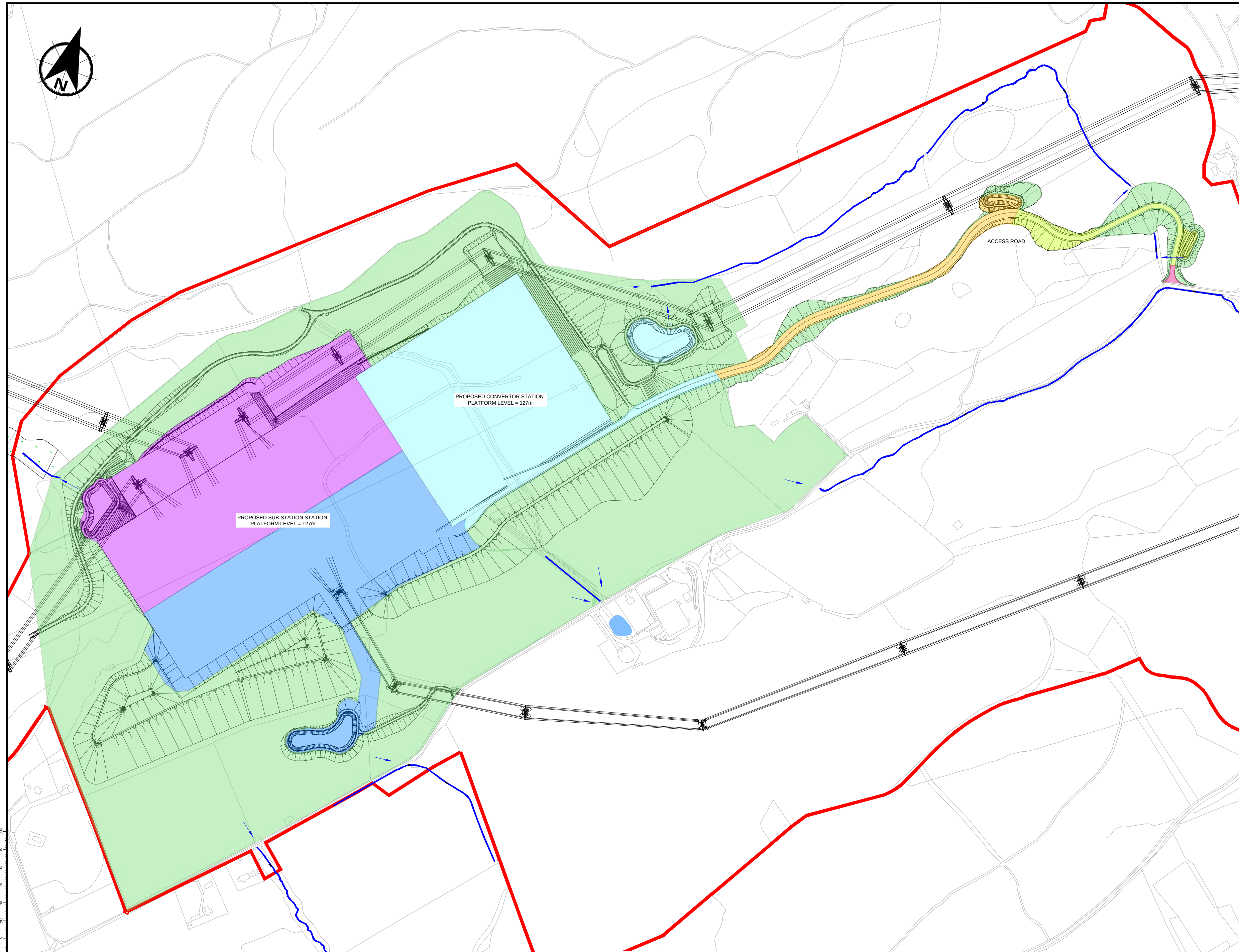


SURFACE WATER DRAINAGE
CATCHMENT PLAN
1 : 3000

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3. ALL DATUM LEVELS ARE IN METRES AND DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.

KEY TO DRAWING

- PLANNING BOUNDARY AREA = 223 Ha
- HVAC WEST CATCHMENT AREA = 10.679 Ha
- HVAC EAST CATCHMENT AREA = 9.682 Ha
- HVDC CATCHMENT AREA = 7.898 Ha
- MAIN ACCESS ROAD CATCHMENT AREA = 1.100 Ha
- MAIN ACCESS ROAD JUNCTION CATCHMENT AREA = 0.500 Ha
- IMPERMEABLE UNATTENUATED CATCHMNET AREA = 0.032HA
- GREENFIELD AND PERMEABLE CATCHMENT
- SURFACE WATERCOURSE
- DRAINAGE OUTFALL

| Rev | Date | Amendment Details | Dr'n | Chk' | App' |
|---|---|---|---|---|---|
| P04 | 28/01/2025 | CATCHMENTS AMENDED | RL | SG | CB |
| P03 | 20/08/2024 | FINAL LAYOUT | RL | SG | CB |
| P02 | 18/06/2024 | LAYOUT UPDATED | RL | RL | CB |
| P01 | 22/05/2024 | FOR COMMENT | RL | RL | CB |

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SWECO

Client

Scottish & Southern Electricity Networks
TRANSMISSION

Project Title

FANELLAN
400kV SWITCHING STATION AND
HVDC CONVERTOR STATION

Drawing Title

PROPOSED SURFACE WATER
CATCHMENT PLAN
SHEET 1 OF 1

Purpose Of Issue

PRELIMINARY

| Status | Status Description |
|---|---|
| S5 | FOR REVIEW AND ACCEPTANCE |

| Drawn | Designed | Checked | Approved |
|---|---|---|---|
| MA | RL | RL | CB |

| Sheet Size | Scale | Sweco Ref | Revision |
|---|---|---|---|
| A1 | 1:3000 | 65209842 | P04 |

Drawing Number

LT459-SWE-XX-XX-D-X-0512

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# Appendix C

## Greenfield Runoff Rates

Fanellan Sub-Station East Catchment

Fanellan Sub-Station West Catchment

HVDC Convertor Station Catchment Per-
manent Access Road Catchment (AR-1)
Permanent Access Road Catchment (AR-2)

## ICP SUDS Mean Annual Flood HVAC EAST

Input

| | | | |
|---|---|---|---|
| Return Period (years) | 200 | Soil | 0.300 |
| Area (ha) | 9.682 | Urban | 0.000 |
| SAAR (mm) | 872 | Region Number | Region 1 |

| **Results** | **l/s** |
|---|---|
| QBAR Rural | 22.8 |
| QBAR Urban | 22.8 |
| Q200 years | 64.1 |
| Q1 year | 19.4 |
| Q30 years | 43.1 |
| Q100 years | 56.6 |

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## FEH Mean Annual Flood HVAC EAST

### Input

| | |
|---|---|
| QMED Method | 2008 |
| Site Location | GB 248397 842374 NH 48397 42374 |
| Area (ha) | 9.682 |
| SAAR (mm) | 872 |
| URBEXT (1990) | 0.0000 |
| SPRHOST | 0.000 |
| BFIHOST | 0.754 |
| FARL | 1.000 |

### Results

QMED Rural (l/s) 23.1 QMED Urban (l/s) n/a

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## ICP SUDS Mean Annual Flood HVAC WEST

Input

| | | | |
| --- | --- | --- | --- |
| Return Period (years) | 200 | Soil | 0.300 |
| Area (ha) | 10.679 | Urban | 0.000 |
| SAAR (mm) | 898 | Region Number | Region 1 |

| **Results** | **l/s** |
| --- | --- |
| QBAR Rural | 26.0 |
| QBAR Urban | 26.0 |
| Q200 years | 73.2 |
| Q1 year | 22.1 |
| Q30 years | 49.2 |
| Q100 years | 64.6 |

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## FEH Mean Annual Flood HVAC WEST

### Input

| | |
|---|---|
| QMED Method | 2008 |
| Site Location | GB 247986 842726 NH 47986 42726 |
| Area (ha) | 10.679 |
| SAAR (mm) | 898 |
| URBEXT (1990) | 0.0000 |
| SPRHOST | 0.000 |
| BFIHOST | 0.687 |
| FARL | 1.000 |

### Results

QMED Rural (l/s) 35.9 QMED Urban (l/s) n/a

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## ICP SUDS Mean Annual Flood HVDC

Input

| | | | |
|---|---|---|---|
| Return Period (years) | 200 | Soil | 0.500 |
| Area (ha) | 7.898 | Urban | 0.000 |
| SAAR (mm) | 870 | Region Number | Region 1 |

| **Results** | **l/s** |
|---|---|
| QBAR Rural | 56.2 |
| QBAR Urban | 56.2 |
| Q200 years | 158.0 |
| Q1 year | 47.8 |
| Q30 years | 106.3 |
| Q100 years | 139.5 |

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ICP SUDS Mean Annual Flood ACCESS ROAD AR-1

Input

| | | | |
|---|---|---|---|
| Return Period (years) | 200 | Soil | 0.500 |
| Area (ha) | 1.100 | Urban | 0.000 |
| SAAR (mm) | 870 | Region Number | Region 1 |

| **Results** | **l/s** |
|---|---|
| QBAR Rural | 7.8 |
| QBAR Urban | 7.8 |
| Q200 years | 22.0 |
| Q1 year | 6.7 |
| Q30 years | 14.8 |
| Q100 years | 19.4 |

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## FEH Mean Annual Flood ACCESS ROAD AR-1

### Input

| | |
|---|---|
| QMED Method | 2008 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Area (ha) | 1.100 |
| SAAR (mm) | 870 |
| URBEXT (1990) | 0.0000 |
| SPRHOST | 0.000 |
| BFIHOST | 0.675 |
| FARL | 1.000 |

### Results

QMED Rural (l/s) 5.1 QMED Urban (l/s) n/a

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## ICP SUDS Mean Annual Flood ACCESS ROAD AR-2

Input

| | | | |
|---|---|---|---|
| Return Period (years) | 2 | Soil | 0.500 |
| Area (ha) | 0.500 | Urban | 0.000 |
| SAAR (mm) | 870 | Region Number | Region 1 |

| **Results** | **l/s** |
|---|---|
| QBAR Rural | 3.6 |
| QBAR Urban | 3.6 |
| Q2 years | 3.2 |
| Q1 year | 3.0 |
| Q30 years | 6.7 |
| Q100 years | 8.8 |

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## FEH Mean Annual Flood ACCESS ROAD AR-2

### Input

| | |
|---|---|
| QMED Method | 2008 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Area (ha) | 0.500 |
| SAAR (mm) | 870 |
| URBEXT (1990) | 0.0000 |
| SPRHOST | 0.000 |
| BFIHOST | 0.675 |
| FARL | 1.000 |

### Results

QMED Rural (l/s) 2.6 QMED Urban (l/s) n/a

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Fanellan

Summary of ReFH 2 Peak Flows

| Network | Description | Return period (yrs) | As-rural peak flow (m^3/s) |
|---|---|---|---|
| HVAC (W) | 2 year | 2 | 0.004160567 |
| HVAC ('E) | 2 year | 2 | 0.017991069 |
| HVDC | 2 year | 2 | 0.031860635 |
| Main Access Road (AR-1) | 2 year | 2 | 0.004354735 |
| Main Access Bellmouth (AR-2) | 2 year | 2 | 0.002130172 |

# Appendix D

## MicroDrainage Calculations

Fanellan HVAC Output (AC (W))

Fanellan HVAC Output (AC (E))

Fanellan HVAC Output (HVDC)

Permanent Access Road Network Output

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

| | |
|---|---|
| Return Period (years) | 2 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 247986 842726 NH 47986 42726 |
| Data Type | Point |
| Maximum Rainfall (mm/hr) | 550 |
| Maximum Time of Concentration (mins) | 30 |
| Foul Sewage (l/s/ha) | 0.000 |
| Volumetric Runoff Coeff. | 0.750 |
| PIMP (%) | 100 |
| Add Flow / Climate Change (%) | 0 |
| Minimum Backdrop Height (m) | 0.200 |
| Maximum Backdrop Height (m) | 1.500 |
| Min Design Depth for Optimisation (m) | 1.200 |
| Min Vel for Auto Design only (m/s) | 1.00 |
| Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

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## Online Controls for Storm

### Orifice Manhole: HVAC (W)15, DS/PN: HVAC (W)2.005, Volume (m³): 193.0

Diameter (m) 0.125 Discharge Coefficient 0.600 Invert Level (m) 125.388

### Orifice Manhole: HVAC (W)21, DS/PN: HVAC (W)4.001, Volume (m³): 102.7

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 126.000

### Hydro-Brake® Optimum Manhole: HVAC (W)28, DS/PN: HVAC (W)1.009, Volume (m³): 19.7

| | |
|---|---|
| Unit Reference | MD-SHE-0208-2600-2023-2600 |
| Design Head (m) | 2.023 |
| Design Flow (l/s) | 26.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 208 |
| Invert Level (m) | 122.500 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.023 | 26.0 |
| Flush-Flo™ | 0.587 | 26.0 |
| Kick-Flo® | 1.263 | 20.7 |
| Mean Flow over Head Range | - | 22.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 7.1 | 1.200 | 22.1 | 3.000 | 31.4 | 7.000 | 47.2 |
| 0.200 | 20.0 | 1.400 | 21.8 | 3.500 | 33.8 | 7.500 | 48.8 |
| 0.300 | 24.1 | 1.600 | 23.2 | 4.000 | 36.0 | 8.000 | 50.4 |
| 0.400 | 25.3 | 1.800 | 24.6 | 4.500 | 38.1 | 8.500 | 51.9 |
| 0.500 | 25.9 | 2.000 | 25.8 | 5.000 | 40.1 | 9.000 | 53.3 |
| 0.600 | 26.0 | 2.200 | 27.0 | 5.500 | 42.0 | 9.500 | 54.7 |
| 0.800 | 25.6 | 2.400 | 28.2 | 6.000 | 43.8 | | |
| 1.000 | 24.5 | 2.600 | 29.3 | 6.500 | 45.5 | | |

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## Storage Structures for Storm

### Infiltration Blanket Manhole: HVAC (W)21, DS/PN: HVAC (W)4.001

| | | | |
|---|---|---|---|
| Infiltration Coefficient Base (m/hr) | 0.00000 | Diameter/Width (m) | 130.0 |
| Safety Factor | 2.0 | Length (m) | 500.0 |
| Porosity | 0.30 | Cap Volume Depth (m) | 0.000 |
| Invert Level (m) | 126.000 | | |

### Tank or Pond Manhole: HVAC (W)28, DS/PN: HVAC (W)1.009

Invert Level (m) 122.500

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1489.0 | 2.500 | 3067.0 |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 2 |
| Number of Online Controls | 3 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| FEH Rainfall Version | 2013 |
| Site Location | GB 247986 842726 NH 47986 42726 |
| Data Type | Point |
| Cv (Summer) | 0.750 |
| Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | ON |
| Analysis Timestep | Fine | Inertia Status | ON |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 200 |
| Climate Change (%) | 42 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| HVAC (W)1.000 | HVAC (W)1 | 30 Summer | 200 | +42% | 200/15 Summer | | |
| HVAC (W)1.001 | HVAC (W)2 | 30 Summer | 200 | +42% | 200/15 Summer | | |
| HVAC (W)1.002 | HVAC (W)3 | 30 Summer | 200 | +42% | 200/15 Summer | | |
| HVAC (W)1.003 | HVAC (W)4 | 30 Summer | 200 | +42% | 200/15 Summer | | |
| HVAC (W)1.004 | HVAC (W)5 | 30 Summer | 200 | +42% | | | |
| HVAC (W)1.005 | HVAC (W)6 | 30 Winter | 200 | +42% | | | |
| HVAC (W)2.000 | HVAC (W)7 | 120 Winter | 200 | +42% | | | |
| HVAC (W)3.000 | HVAC (W)8 | 15 Winter | 200 | +42% | | | |
| HVAC (W)3.001 | HVAC (W)9 | 15 Winter | 200 | +42% | | | |
| HVAC (W)3.002 | HVAC (W)10 | 15 Winter | 200 | +42% | | | |
| HVAC (W)2.001 | HVAC (W)11 | 120 Winter | 200 | +42% | | | |
| HVAC (W)2.002 | HVAC (W)12 | 120 Winter | 200 | +42% | | | |
| HVAC (W)2.003 | HVAC (W)13 | 120 Winter | 200 | +42% | | | |
| HVAC (W)2.004 | HVAC (W)14 | 120 Winter | 200 | +42% | | | |
| HVAC (W)2.005 | HVAC (W)15 | 120 Winter | 200 | +42% | 200/15 Summer | | |
| HVAC (W)2.006 | HVAC (W)16 | 120 Winter | 200 | +42% | | | |
| HVAC (W)1.006 | HVAC (W)17 | 30 Winter | 200 | +42% | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|
| HVAC (W)1.000 | HVAC (W)1 | | 126.629 | 0.579 | 0.000 | 0.49 | | 76.7 |
| HVAC (W)1.001 | HVAC (W)2 | | 126.592 | 0.645 | 0.000 | 1.02 | | 161.9 |
| HVAC (W)1.002 | HVAC (W)3 | | 126.424 | 0.612 | 0.000 | 1.42 | | 226.5 |
| HVAC (W)1.003 | HVAC (W)4 | | 126.068 | 0.409 | 0.000 | 1.65 | | 226.7 |
| HVAC (W)1.004 | HVAC (W)5 | | 125.972 | -1.028 | 0.000 | 0.12 | | 1024.4 |
| HVAC (W)1.005 | HVAC (W)6 | | 125.312 | -1.688 | 0.000 | 0.06 | | 913.8 |
| HVAC (W)2.000 | HVAC (W)7 | | 126.889 | -0.111 | 0.000 | 0.01 | | 16.7 |
| HVAC (W)3.000 | HVAC (W)8 | | 136.308 | -0.614 | 0.000 | 0.15 | | 505.6 |
| HVAC (W)3.001 | HVAC (W)9 | | 133.679 | -0.544 | 0.000 | 0.22 | | 495.4 |
| HVAC (W)3.002 | HVAC (W)10 | | 133.275 | -0.225 | 0.000 | 0.58 | | 500.3 |
| HVAC (W)2.001 | HVAC (W)11 | | 126.888 | -0.112 | 0.000 | 0.06 | | 194.3 |
| HVAC (W)2.002 | HVAC (W)12 | | 126.864 | -0.136 | 0.000 | 0.10 | | 228.6 |
| HVAC (W)2.003 | HVAC (W)13 | | 126.801 | -0.199 | 0.000 | 0.05 | | 166.5 |
| HVAC (W)2.004 | HVAC (W)14 | | 126.753 | -0.247 | 0.000 | 0.02 | | 70.8 |
| HVAC (W)2.005 | HVAC (W)15 | | 126.722 | 0.659 | 0.000 | 0.06 | | 29.1 |
| HVAC (W)2.006 | HVAC (W)16 | | 125.437 | -1.563 | 0.000 | 0.01 | | 29.1 |
| HVAC (W)1.006 | HVAC (W)17 | | 124.917 | -0.373 | 0.000 | 0.50 | | 934.8 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| HVAC (W)1.000 | HVAC (W)1 | SURCHARGED | |
| HVAC (W)1.001 | HVAC (W)2 | SURCHARGED | |
| HVAC (W)1.002 | HVAC (W)3 | SURCHARGED | |
| HVAC (W)1.003 | HVAC (W)4 | SURCHARGED | |
| HVAC (W)1.004 | HVAC (W)5 | OK | |
| HVAC (W)1.005 | HVAC (W)6 | OK | |
| HVAC (W)2.000 | HVAC (W)7 | FLOOD RISK* | |
| HVAC (W)3.000 | HVAC (W)8 | OK | |
| HVAC (W)3.001 | HVAC (W)9 | OK | |
| HVAC (W)3.002 | HVAC (W)10 | OK* | |
| HVAC (W)2.001 | HVAC (W)11 | FLOOD RISK* | |
| HVAC (W)2.002 | HVAC (W)12 | FLOOD RISK* | |
| HVAC (W)2.003 | HVAC (W)13 | FLOOD RISK* | |
| HVAC (W)2.004 | HVAC (W)14 | FLOOD RISK* | |
| HVAC (W)2.005 | HVAC (W)15 | FLOOD RISK* | |
| HVAC (W)2.006 | HVAC (W)16 | OK | |
| HVAC (W)1.006 | HVAC (W)17 | OK* | |

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| HVAC (W)1.007 | HVAC (W)18 | 10080 Winter | 200 | +42% | 200/15 Summer | |
| HVAC (W)1.008 | HVAC (W)19 | 10080 Winter | 200 | +42% | 200/120 Winter | |
| HVAC (W)4.000 | HVAC (W)20 | 15 Winter | 200 | +42% | | |
| HVAC (W)4.001 | HVAC (W)21 | 10080 Winter | 200 | +42% | 200/30 Winter | |
| HVAC (W)4.002 | HVAC (W)22 | 10080 Winter | 200 | +42% | | |
| HVAC (W)4.003 | HVAC (W)23 | 10080 Winter | 200 | +42% | | |
| HVAC (W)4.004 | HVAC (W)24 | 10080 Winter | 200 | +42% | | |
| HVAC (W)5.000 | HVAC (W)25 | 360 Winter | 200 | +42% | | |
| HVAC (W)5.001 | HVAC (W)26 | 360 Winter | 200 | +42% | | |
| HVAC (W)4.005 | HVAC (W)25 | 7200 Winter | 200 | +42% | 200/5760 Winter | |
| HVAC (W)4.006 | HVAC (W)26 | 7200 Winter | 200 | +42% | 200/120 Winter | 200/10080 Winter |
| HVAC (W)4.007 | HVAC (W)27 | 10080 Winter | 200 | +42% | 200/120 Winter | |
| HVAC (W)1.009 | HVAC (W)28 | 10080 Winter | 200 | +42% | 200/30 Winter | |
| HVAC (W)1.010 | HVAC (W)29 | 10080 Winter | 200 | +42% | | |
| HVAC (W)1.011 | HVAC (W)30 | 10080 Winter | 200 | +42% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|
| HVAC (W)1.007 | HVAC (W)18 | | | 124.523 | 0.633 | 0.000 | 0.06 | |
| HVAC (W)1.008 | HVAC (W)19 | | | 124.522 | 0.696 | 0.000 | 0.04 | |
| HVAC (W)4.000 | HVAC (W)20 | | | 126.676 | -1.424 | 0.000 | 0.07 | |
| HVAC (W)4.001 | HVAC (W)21 | | | 126.539 | 0.389 | 0.000 | 0.40 | |
| HVAC (W)4.002 | HVAC (W)22 | | | 125.505 | -0.195 | 0.000 | 0.27 | |
| HVAC (W)4.003 | HVAC (W)23 | | | 125.205 | -0.195 | 0.000 | 0.27 | |
| HVAC (W)4.004 | HVAC (W)24 | | | 124.906 | -0.194 | 0.000 | 0.27 | |
| HVAC (W)5.000 | HVAC (W)25 | | | 125.350 | -0.150 | 0.000 | 0.00 | |
| HVAC (W)5.001 | HVAC (W)26 | | | 124.764 | -0.150 | 0.000 | 0.00 | |
| HVAC (W)4.005 | HVAC (W)25 | | | 124.601 | 0.041 | 0.000 | 0.09 | |
| HVAC (W)4.006 | HVAC (W)26 | | | 124.591 | 0.872 | 0.000 | 0.26 | |
| HVAC (W)4.007 | HVAC (W)27 | | | 124.547 | 0.882 | 0.000 | 0.19 | |
| HVAC (W)1.009 | HVAC (W)28 | | | 124.521 | 1.271 | 0.000 | 0.04 | |
| HVAC (W)1.010 | HVAC (W)29 | | | 122.486 | -0.191 | 0.000 | 0.06 | |
| HVAC (W)1.011 | HVAC (W)30 | | | 111.532 | -0.145 | 0.000 | 0.27 | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| HVAC (W)1.007 | HVAC (W)18 | 36.4 | SURCHARGED | |
| HVAC (W)1.008 | HVAC (W)19 | 36.3 | SURCHARGED | |
| HVAC (W)4.000 | HVAC (W)20 | 4491.4 | OK | |
| HVAC (W)4.001 | HVAC (W)21 | 14.6 | SURCHARGED | |
| HVAC (W)4.002 | HVAC (W)22 | 14.6 | OK | |
| HVAC (W)4.003 | HVAC (W)23 | 14.6 | OK | |
| HVAC (W)4.004 | HVAC (W)24 | 14.6 | OK | |

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| HVAC (W)5.000 | HVAC (W)25 | 0.0 | OK | |
| HVAC (W)5.001 | HVAC (W)26 | 0.0 | OK | |
| HVAC (W)4.005 | HVAC (W)25 | 14.3 | SURCHARGED | |
| HVAC (W)4.006 | HVAC (W)26 | 14.6 | SURCHARGED | |
| HVAC (W)4.007 | HVAC (W)27 | 15.0 | SURCHARGED | |
| HVAC (W)1.009 | HVAC (W)28 | 26.0 | SURCHARGED* | |
| HVAC (W)1.010 | HVAC (W)29 | 26.0 | OK | |
| HVAC (W)1.011 | HVAC (W)30 | 26.0 | OK* | |

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## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

| | |
| --- | --- |
| Return Period (years) | 2 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248397 842374 NH 48397 42374 |
| Data Type | Point |
| Maximum Rainfall (mm/hr) | 550 |
| Maximum Time of Concentration (mins) | 30 |
| Foul Sewage (l/s/ha) | 0.000 |
| Volumetric Runoff Coeff. | 0.750 |
| PIMP (%) | 100 |
| Add Flow / Climate Change (%) | 42 |
| Minimum Backdrop Height (m) | 0.200 |
| Maximum Backdrop Height (m) | 1.500 |
| Min Design Depth for Optimisation (m) | 1.200 |
| Min Vel for Auto Design only (m/s) | 1.00 |
| Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

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## Online Controls for Storm

### Orifice Manhole: HVAC(E)-2, DS/PN: HVAC(E)-1.001, Volume (m³): 193.4

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 126.000

### Hydro-Brake® Optimum Manhole: HVAC(E)-20, DS/PN: HVAC(E)-1.011, Volume (m³): 787.7

| | |
|---|---|
| Unit Reference | MD-SHE-0184-1740-1196-1740 |
| Design Head (m) | 1.196 |
| Design Flow (l/s) | 17.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 184 |
| Invert Level (m) | 104.500 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.196 | 17.4 |
| Flush-Flo™ | 0.374 | 17.4 |
| Kick-Flo® | 0.819 | 14.5 |
| Mean Flow over Head Range | - | 14.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.5 | 1.200 | 17.4 | 3.000 | 27.0 | 7.000 | 40.6 |
| 0.200 | 16.3 | 1.400 | 18.8 | 3.500 | 29.1 | 7.500 | 42.0 |
| 0.300 | 17.3 | 1.600 | 20.0 | 4.000 | 31.0 | 8.000 | 43.3 |
| 0.400 | 17.4 | 1.800 | 21.1 | 4.500 | 32.8 | 8.500 | 44.6 |
| 0.500 | 17.2 | 2.000 | 22.2 | 5.000 | 34.5 | 9.000 | 45.9 |
| 0.600 | 16.8 | 2.200 | 23.3 | 5.500 | 36.1 | 9.500 | 47.1 |
| 0.800 | 15.0 | 2.400 | 24.3 | 6.000 | 37.7 | | |
| 1.000 | 16.0 | 2.600 | 25.2 | 6.500 | 39.2 | | |

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## Storage Structures for Storm

### Infiltration Blanket Manhole: HVAC(E)-2, DS/PN: HVAC(E)-1.001

| | | | |
|---|---|---|---|
| Infiltration Coefficient Base (m/hr) | 0.00000 | Diameter/Width (m) | 130.0 |
| Safety Factor | 2.0 | Length (m) | 500.0 |
| Porosity | 0.30 | Cap Volume Depth (m) | 0.000 |
| Invert Level (m) | 126.000 | | |

### Tank or Pond Manhole: HVAC(E)-20, DS/PN: HVAC(E)-1.011

Invert Level (m) 104.500

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 2338.0 | 2.000 | 4397.0 |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248397 842374 NH 48397 42374 |
| Data Type | Point |
| Cv (Summer) | 0.750 |
| Cv (Winter) | 0.840 |

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 200 |
| Climate Change (%) | 42 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| HVAC(E)-1.000 | HVAC(E)-1 | 15 Winter | 200 | +42% | | | |
| HVAC(E)-1.001 | HVAC(E)-2 | 10080 Winter | 200 | +42% | 200/60 Winter | | |
| HVAC(E)-2.000 | HVAC(E)-3 | 15 Winter | 200 | +42% | | | |
| HVAC(E)-2.001 | HVAC(E)-4 | 15 Winter | 200 | +42% | | | |
| HVAC(E)-2.002 | HVAC(E)-5 | 15 Winter | 200 | +42% | | | |
| HVAC(E)-2.003 | HVAC(E)-6 | 15 Winter | 200 | +42% | | | |
| HVAC(E)-1.002 | HVAC(E)-7 | 30 Summer | 200 | +42% | | | |
| HVAC(E)-1.003 | HVAC(E)-8 | 30 Winter | 200 | +42% | | | |
| HVAC(E)-3.000 | HVAC(E)-11 | 15 Winter | 200 | +42% | 200/15 Summer | | |
| HVAC(E)-3.001 | HVAC(E)-12 | 15 Winter | 200 | +42% | 200/15 Summer | | |
| HVAC(E)-3.002 | HVAC(E)-13 | 15 Winter | 200 | +42% | 200/15 Summer | | |
| HVAC(E)-1.004 | HVAC(E)-14 | 30 Summer | 200 | +42% | | | |
| HVAC(E)-1.005 | HVAC(E)-15 | 30 Winter | 200 | +42% | 200/15 Summer | | |
| HVAC(E)-1.006 | HVAC(E)-16 | 30 Winter | 200 | +42% | | | |
| HVAC(E)-1.007 | HVAC(E)-16 | 30 Winter | 200 | +42% | | | |
| HVAC(E)-1.008 | HVAC(E)-17 | 30 Winter | 200 | +42% | | | |
| HVAC(E)-1.009 | HVAC(E)-18 | 30 Winter | 200 | +42% | 200/15 Summer | | |

Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|
| HVAC(E)-1.000 | HVAC(E)-1 | | 126.677 | -1.333 | 0.000 | 0.10 | | 4991.7 |
| HVAC(E)-1.001 | HVAC(E)-2 | | 126.589 | 0.364 | 0.000 | 0.21 | | 15.3 |
| HVAC(E)-2.000 | HVAC(E)-3 | | 125.399 | -0.401 | 0.000 | 0.22 | | 79.1 |
| HVAC(E)-2.001 | HVAC(E)-4 | | 125.275 | -0.268 | 0.000 | 0.46 | | 144.6 |
| HVAC(E)-2.002 | HVAC(E)-5 | | 125.191 | -0.177 | 0.000 | 0.78 | | 239.7 |
| HVAC(E)-2.003 | HVAC(E)-6 | | 124.934 | -0.176 | 0.000 | 0.81 | | 311.8 |
| HVAC(E)-1.002 | HVAC(E)-7 | | 124.473 | -0.230 | 0.000 | 0.69 | | 336.8 |
| HVAC(E)-1.003 | HVAC(E)-8 | | 124.263 | -0.140 | 0.000 | 0.94 | | 341.1 |
| HVAC(E)-3.000 | HVAC(E)-11 | | 126.831 | 1.306 | 0.000 | 1.30 | | 142.1 |
| HVAC(E)-3.001 | HVAC(E)-12 | | 126.167 | 0.992 | 0.000 | 2.42 | | 202.6 |
| HVAC(E)-3.002 | HVAC(E)-13 | | 125.062 | 0.047 | 0.000 | 1.10 | | 386.2 |
| HVAC(E)-1.004 | HVAC(E)-14 | | 123.995 | -0.208 | 0.000 | 0.74 | | 804.2 |
| HVAC(E)-1.005 | HVAC(E)-15 | | 118.747 | 0.147 | 0.000 | 1.14 | | 807.4 |
| HVAC(E)-1.006 | HVAC(E)-16 | | 117.717 | -0.683 | 0.000 | 0.14 | | 856.3 |
| HVAC(E)-1.007 | HVAC(E)-16 | | 117.121 | -1.981 | 0.000 | 0.01 | | 869.8 |
| HVAC(E)-1.008 | HVAC(E)-17 | | 107.326 | -0.574 | 0.000 | 0.28 | | 962.1 |
| HVAC(E)-1.009 | HVAC(E)-18 | | 106.102 | 0.802 | 0.000 | 2.77 | | 962.1 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| HVAC(E)-1.000 | HVAC(E)-1 | OK | |
| HVAC(E)-1.001 | HVAC(E)-2 | SURCHARGED | |
| HVAC(E)-2.000 | HVAC(E)-3 | OK | |
| HVAC(E)-2.001 | HVAC(E)-4 | OK | |
| HVAC(E)-2.002 | HVAC(E)-5 | OK | |
| HVAC(E)-2.003 | HVAC(E)-6 | OK | |
| HVAC(E)-1.002 | HVAC(E)-7 | OK | |
| HVAC(E)-1.003 | HVAC(E)-8 | OK | |
| HVAC(E)-3.000 | HVAC(E)-11 | FLOOD RISK | |
| HVAC(E)-3.001 | HVAC(E)-12 | SURCHARGED | |
| HVAC(E)-3.002 | HVAC(E)-13 | SURCHARGED | |
| HVAC(E)-1.004 | HVAC(E)-14 | OK | |
| HVAC(E)-1.005 | HVAC(E)-15 | SURCHARGED | |
| HVAC(E)-1.006 | HVAC(E)-16 | OK | |
| HVAC(E)-1.007 | HVAC(E)-16 | OK | |
| HVAC(E)-1.008 | HVAC(E)-17 | OK* | |
| HVAC(E)-1.009 | HVAC(E)-18 | SURCHARGED | |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| HVAC(E)-1.010 | HVAC(E)-19 | 10080 Winter | 200 | +42% | | | |
| HVAC(E)-1.011 | HVAC(E)-20 | 10080 Winter | 200 | +42% | 200/120 Winter | | |
| HVAC(E)-1.012 | HVAC(E)-21 | 10080 Winter | 200 | +42% | | | |
| HVAC(E)-1.013 | HVAC(E)-22 | 8640 Summer | 200 | +42% | | | |
| HVAC(E)-1.014 | HVAC(E)-23 | 8640 Winter | 200 | +42% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|
| HVAC(E)-1.010 | HVAC(E)-19 | | 105.779 | -0.021 | 0.000 | 0.00 | | 31.4 |
| HVAC(E)-1.011 | HVAC(E)-20 | | 105.682 | 0.582 | 0.000 | 0.05 | | 17.4 |
| HVAC(E)-1.012 | HVAC(E)-21 | | 104.459 | -0.166 | 0.000 | 0.15 | | 17.4 |
| HVAC(E)-1.013 | HVAC(E)-22 | | 103.283 | -1.317 | 0.000 | 0.00 | | 17.4 |
| HVAC(E)-1.014 | HVAC(E)-23 | | 103.100 | -0.490 | 0.000 | 0.07 | | 17.4 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| HVAC(E)-1.010 | HVAC(E)-19 | OK | |
| HVAC(E)-1.011 | HVAC(E)-20 | SURCHARGED | |
| HVAC(E)-1.012 | HVAC(E)-21 | OK | |
| HVAC(E)-1.013 | HVAC(E)-22 | OK | |
| HVAC(E)-1.014 | HVAC(E)-23 | OK* | |

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## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

| | |
|---|---|
| Return Period (years) | 2 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Data Type | Point |
| Maximum Rainfall (mm/hr) | 300 |
| Maximum Time of Concentration (mins) | 30 |
| Foul Sewage (l/s/ha) | 0.000 |
| Volumetric Runoff Coeff. | 0.750 |
| PIMP (%) | 100 |
| Add Flow / Climate Change (%) | 42 |
| Minimum Backdrop Height (m) | 0.200 |
| Maximum Backdrop Height (m) | 1.500 |
| Min Design Depth for Optimisation (m) | 1.200 |
| Min Vel for Auto Design only (m/s) | 1.00 |
| Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

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## Online Controls for Storm

### Hydro-Brake® Optimum Manhole: HVDC 29, DS/PN: HVDC1.006, Volume ($m^3$): 94.5

| | |
|---|---|
| Unit Reference | MD-SHE-0215-2760-1972-2760 |
| Design Head (m) | 1.972 |
| Design Flow (l/s) | 27.6 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 215 |
| Invert Level (m) | 115.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.972 | 27.6 |
| Flush-Flo™ | 0.581 | 27.6 |
| Kick-Flo® | 1.250 | 22.2 |
| Mean Flow over Head Range | - | 23.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 7.3 | 1.200 | 23.3 | 3.000 | 33.7 | 7.000 | 50.8 |
| 0.200 | 20.9 | 1.400 | 23.4 | 3.500 | 36.3 | 7.500 | 52.5 |
| 0.300 | 25.6 | 1.600 | 25.0 | 4.000 | 38.7 | 8.000 | 54.2 |
| 0.400 | 26.9 | 1.800 | 26.4 | 4.500 | 41.0 | 8.500 | 55.8 |
| 0.500 | 27.5 | 2.000 | 27.8 | 5.000 | 43.2 | 9.000 | 57.4 |
| 0.600 | 27.6 | 2.200 | 29.1 | 5.500 | 45.2 | 9.500 | 58.9 |
| 0.800 | 27.1 | 2.400 | 30.3 | 6.000 | 47.1 | | |
| 1.000 | 26.0 | 2.600 | 31.5 | 6.500 | 49.0 | | |

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## Storage Structures for Storm

### Tank or Pond Manhole: HVDC 29, DS/PN: HVDC1.006

Invert Level (m) 115.000

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 3514.0 | 3.000 | 5996.0 |

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Data Type | Point |
| Cv (Summer) | 0.750 |
| Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | ON |
| Analysis Timestep | Fine | Inertia Status | ON |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 200 |
| Climate Change (%) | 42 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| HVDC1.000 | HVDC 1 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC2.000 | HVDC 2 | 15 Winter | 200 | +42% | | | | |
| HVDC2.001 | HVDC 3 | 15 Winter | 200 | +42% | | | | |
| HVDC2.002 | HVDC 4 | 15 Winter | 200 | +42% | | | | |
| HVDC2.003 | HVDC 5 | 15 Winter | 200 | +42% | | | | |
| HVDC2.004 | HVDC 6 | 30 Winter | 200 | +42% | | | | |
| HVDC2.005 | HVDC 7 | 30 Winter | 200 | +42% | 200/15 Winter | | | |
| HVDC2.006 | HVDC 8 | 30 Winter | 200 | +42% | | | | |
| HVDC3.000 | HVDC 9 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC3.001 | HVDC 10 | 30 Summer | 200 | +42% | 200/15 Summer | | | |
| HVDC1.001 | HVDC 11 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC1.002 | HVDC 12 | 15 Winter | 200 | +42% | | | | |
| HVDC1.003 | HVDC 13 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC1.004 | HVDC 14 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC4.000 | HVDC 15 | 15 Winter | 200 | +42% | | | | |
| HVDC4.001 | HVDC 16 | 15 Winter | 200 | +42% | | | | |
| HVDC4.002 | HVDC 17 | 15 Winter | 200 | +42% | | | | |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| HVDC1.000 | HVDC 1 | 124.622 | 0.722 | 0.000 | 3.86 | | 1980.8 | SURCHARGED | |
| HVDC2.000 | HVDC 2 | 125.697 | -0.178 | 0.000 | 0.51 | | 49.1 | OK | |
| HVDC2.001 | HVDC 3 | 125.572 | -0.105 | 0.000 | 0.83 | | 80.0 | OK | |
| HVDC2.002 | HVDC 4 | 125.380 | -0.099 | 0.000 | 0.89 | | 78.0 | OK | |
| HVDC2.003 | HVDC 5 | 125.303 | -0.138 | 0.000 | 0.78 | | 161.8 | OK | |
| HVDC2.004 | HVDC 6 | 125.147 | -0.020 | 0.000 | 0.91 | | 183.8 | OK | |
| HVDC2.005 | HVDC 7 | 124.984 | 0.012 | 0.000 | 1.07 | | 217.9 | SURCHARGED | |
| HVDC2.006 | HVDC 8 | 124.419 | -0.345 | 0.000 | 0.21 | | 217.8 | OK | |
| HVDC3.000 | HVDC 9 | 125.274 | 2.737 | 0.000 | 1.22 | | 14.8 | SURCHARGED | |
| HVDC3.001 | HVDC 10 | 124.889 | 2.651 | 0.000 | 2.21 | | 32.1 | SURCHARGED | |
| HVDC1.001 | HVDC 11 | 122.306 | 0.639 | 0.000 | 1.78 | | 2202.2 | SURCHARGED | |
| HVDC1.002 | HVDC 12 | 120.955 | -0.412 | 0.000 | 0.57 | | 2199.7 | OK | |
| HVDC1.003 | HVDC 13 | 119.028 | 0.861 | 0.000 | 0.95 | | 2151.4 | SURCHARGED | |
| HVDC1.004 | HVDC 14 | 118.100 | 0.933 | 0.000 | 1.73 | | 2141.0 | SURCHARGED | |
| HVDC4.000 | HVDC 15 | 125.649 | -0.076 | 0.000 | 0.75 | | 48.0 | OK | |
| HVDC4.001 | HVDC 16 | 124.168 | -0.132 | 0.000 | 0.36 | | 48.2 | OK | |
| HVDC4.002 | HVDC 17 | 121.727 | -0.073 | 0.000 | 0.77 | | 93.5 | OK | |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| HVDC4.003 | HVDC 18 | 15 Winter | 200 | +42% | | | | |
| HVDC1.005 | HVDC 19 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC5.000 | HVDC 20 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC6.000 | HVDC 21 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC6.001 | HVDC 22 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC5.001 | HVDC 23 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC5.002 | HVDC 24 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC5.003 | HVDC 25 | 15 Winter | 200 | +42% | | | | |
| HVDC5.004 | HVDC 26 | 15 Winter | 200 | +42% | | | | |
| HVDC5.005 | HVDC 27 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC5.006 | HVDC 28 | 4320 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC1.006 | HVDC 29 | 4320 Winter | 200 | +42% | 200/15 Summer | | | |
| HVDC1.007 | HVDC 30 | 7200 Winter | 200 | +42% | | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| HVDC4.003 | HVDC 18 | 119.351 | -0.089 | 0.000 | 0.65 | | 92.5 | OK | |
| HVDC1.005 | HVDC 19 | 117.187 | 0.170 | 0.000 | 1.31 | | 2204.4 | SURCHARGED | |
| HVDC5.000 | HVDC 20 | 126.954 | 3.054 | 0.000 | 2.01 | | 2484.7 | FLOOD RISK | |
| HVDC6.000 | HVDC 21 | 126.009 | 0.509 | 0.000 | 0.37 | | 28.8 | SURCHARGED | |
| HVDC6.001 | HVDC 22 | 125.924 | 0.849 | 0.000 | 1.02 | | 78.2 | SURCHARGED | |
| HVDC5.001 | HVDC 23 | 125.720 | 2.120 | 0.000 | 2.01 | | 2478.5 | SURCHARGED | |
| HVDC5.002 | HVDC 24 | 124.463 | 1.163 | 0.000 | 2.20 | | 2466.3 | SURCHARGED | |
| HVDC5.003 | HVDC 25 | 122.855 | -0.145 | 0.000 | 1.00 | | 2427.7 | OK | |
| HVDC5.004 | HVDC 26 | 121.153 | -0.447 | 0.000 | 0.51 | | 2427.2 | OK | |
| HVDC5.005 | HVDC 27 | 117.784 | 1.184 | 0.000 | 1.96 | | 2421.9 | FLOOD RISK | |
| HVDC5.006 | HVDC 28 | 116.962 | 0.512 | 0.000 | 0.03 | | 64.6 | SURCHARGED | |
| HVDC1.006 | HVDC 29 | 116.961 | 1.661 | 0.000 | 0.04 | | 27.6 | SURCHARGED | |
| HVDC1.007 | HVDC 30 | 107.065 | -0.235 | 0.000 | 0.11 | | 27.6 | OK | |

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## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

| | |
|---|---|
| Return Period (years) | 2 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Data Type | Point |
| Maximum Rainfall (mm/hr) | 550 |
| Maximum Time of Concentration (mins) | 30 |
| Foul Sewage (l/s/ha) | 0.000 |
| Volumetric Runoff Coeff. | 0.750 |
| PIMP (%) | 100 |
| Add Flow / Climate Change (%) | 42 |
| Minimum Backdrop Height (m) | 0.200 |
| Maximum Backdrop Height (m) | 1.500 |
| Min Design Depth for Optimisation (m) | 1.200 |
| Min Vel for Auto Design only (m/s) | 1.00 |
| Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

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## Online Controls for Storm

### Hydro-Brake® Optimum Manhole: AR-1 20, DS/PN: AR-11.010, Volume (m³): 11.5

| | |
|---|---|
| Unit Reference | MD-SHE-0087-4300-1820-4300 |
| Design Head (m) | 1.820 |
| Design Flow (l/s) | 4.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 87 |
| Invert Level (m) | 70.000 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.820 | 4.3 |
| Flush-Flo™ | 0.380 | 3.6 |
| Kick-Flo® | 0.774 | 2.9 |
| Mean Flow over Head Range | - | 3.4 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 2.6 | 1.200 | 3.5 | 3.000 | 5.4 | 7.000 | 8.1 |
| 0.200 | 3.4 | 1.400 | 3.8 | 3.500 | 5.8 | 7.500 | 8.4 |
| 0.300 | 3.6 | 1.600 | 4.0 | 4.000 | 6.2 | 8.000 | 8.6 |
| 0.400 | 3.6 | 1.800 | 4.3 | 4.500 | 6.6 | 8.500 | 8.9 |
| 0.500 | 3.6 | 2.000 | 4.5 | 5.000 | 6.9 | 9.000 | 9.1 |
| 0.600 | 3.4 | 2.200 | 4.7 | 5.500 | 7.2 | 9.500 | 9.4 |
| 0.800 | 2.9 | 2.400 | 4.9 | 6.000 | 7.5 | | |
| 1.000 | 3.3 | 2.600 | 5.1 | 6.500 | 7.8 | | |

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## Storage Structures for Storm

### Tank or Pond Manhole: AR-1 20, DS/PN: AR-11.010

Invert Level (m) 70.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
| --- | --- | --- | --- |
| 0.000 | 271.0 | 2.200 | 1059.1 |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Data Type | Point |
| Cv (Summer) | 0.750 |
| Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 200 |
| Climate Change (%) | 42 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| AR-11.000 | AR-1 1 | 15 Winter | 200 | +42% | | | | |
| AR-11.001 | AR-1 2 | 15 Winter | 200 | +42% | | | | |
| AR-11.002 | AR-1 3 | 15 Winter | 200 | +42% | | | | |
| AR-11.003 | AR-1 4 | 15 Winter | 200 | +42% | | | | |
| AR-11.004 | AR-1 5 | 15 Winter | 200 | +42% | | | | |
| AR-11.005 | AR-1 6 | 15 Winter | 200 | +42% | | | | |
| AR-11.006 | AR-1 7 | 15 Winter | 200 | +42% | | | | |
| AR-11.007 | AR-1 8 | 15 Winter | 200 | +42% | | | | |
| AR-12.000 | AR-1 9 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-12.001 | AR-1 10 | 15 Winter | 200 | +42% | | | | |
| AR-12.002 | AR-1 11 | 15 Winter | 200 | +42% | | | | |
| AR-12.003 | AR-1 12 | 15 Winter | 200 | +42% | | | | |
| AR-12.004 | AR-1 13 | 15 Winter | 200 | +42% | | | | |
| AR-12.005 | AR-1 14 | 15 Winter | 200 | +42% | | | | |
| AR-12.006 | AR-1 15 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-12.007 | AR-1 16 | 15 Winter | 200 | +42% | | | | |
| AR-12.008 | AR-1 17 | 15 Winter | 200 | +42% | 200/15 Summer | | | |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| AR-11.000 | AR-1 1 | 120.662 | -0.318 | 0.000 | 0.06 | | 44.3 | OK | |
| AR-11.001 | AR-1 2 | 116.637 | -0.293 | 0.000 | 0.09 | | 104.8 | FLOOD RISK* | |
| AR-11.002 | AR-1 3 | 105.439 | -0.231 | 0.000 | 0.20 | | 197.7 | FLOOD RISK* | |
| AR-11.003 | AR-1 4 | 93.827 | -0.213 | 0.000 | 0.25 | | 255.4 | FLOOD RISK* | |
| AR-11.004 | AR-1 5 | 86.450 | -0.160 | 0.000 | 0.38 | | 302.6 | FLOOD RISK* | |
| AR-11.005 | AR-1 6 | 83.322 | -0.168 | 0.000 | 0.36 | | 326.3 | FLOOD RISK* | |
| AR-11.006 | AR-1 7 | 77.593 | -0.177 | 0.000 | 0.34 | | 337.7 | FLOOD RISK* | |
| AR-11.007 | AR-1 8 | 73.237 | -0.203 | 0.000 | 0.58 | | 338.1 | OK* | |
| AR-12.000 | AR-1 9 | 119.646 | 0.041 | 0.000 | 1.05 | | 37.6 | SURCHARGED | |
| AR-12.001 | AR-1 10 | 119.180 | -0.134 | 0.000 | 0.34 | | 37.1 | OK | |
| AR-12.002 | AR-1 11 | 115.726 | -0.179 | 0.000 | 0.33 | | 99.1 | OK | |
| AR-12.003 | AR-1 12 | 105.929 | -0.146 | 0.000 | 0.50 | | 147.8 | OK | |
| AR-12.004 | AR-1 13 | 96.497 | -0.098 | 0.000 | 0.76 | | 203.6 | OK | |
| AR-12.005 | AR-1 14 | 88.649 | -0.086 | 0.000 | 0.84 | | 226.5 | OK | |
| AR-12.006 | AR-1 15 | 80.974 | 0.159 | 0.000 | 1.01 | | 290.9 | SURCHARGED | |
| AR-12.007 | AR-1 16 | 75.739 | -0.156 | 0.000 | 0.64 | | 290.3 | OK | |
| AR-12.008 | AR-1 17 | 72.898 | 0.733 | 0.000 | 1.27 | | 285.3 | FLOOD RISK | |

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| AR-11.008 | AR-1 18 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-11.009 | AR-1 19 | 2880 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-11.010 | AR-1 20 | 2880 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-11.011 | AR-1 21 | 2880 Winter | 200 | +42% | | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| AR-11.008 | AR-1 18 | 72.671 | 0.666 | 0.000 | 1.23 | | 618.1 | SURCHARGED | |
| AR-11.009 | AR-1 19 | 71.811 | 0.606 | 0.000 | 0.06 | | 20.8 | SURCHARGED | |
| AR-11.010 | AR-1 20 | 71.810 | 1.210 | 0.000 | 0.02 | | 4.3 | SURCHARGED | |
| AR-11.011 | AR-1 21 | 69.995 | -0.590 | 0.000 | 0.00 | | 4.3 | OK | |

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## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

| | |
|---|---|
| Return Period (years) | 2 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Data Type | Point |
| Maximum Rainfall (mm/hr) | 550 |
| Maximum Time of Concentration (mins) | 30 |
| Foul Sewage (l/s/ha) | 0.000 |
| Volumetric Runoff Coeff. | 0.750 |
| PIMP (%) | 100 |
| Add Flow / Climate Change (%) | 42 |
| Minimum Backdrop Height (m) | 0.200 |
| Maximum Backdrop Height (m) | 1.500 |
| Min Design Depth for Optimisation (m) | 1.200 |
| Min Vel for Auto Design only (m/s) | 1.00 |
| Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

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## Online Controls for Storm

### Hydro-Brake® Optimum Manhole: AR-2:27, DS/PN: AR-2:1.008, Volume ($m^3$): 6.7

| | |
|---|---|
| Unit Reference | MD-SHE-0064-2100-1336-2100 |
| Design Head (m) | 1.336 |
| Design Flow (l/s) | 2.1 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 64 |
| Invert Level (m) | 37.300 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.336 | 2.1 |
| Flush-Flo™ | 0.281 | 1.8 |
| Kick-Flo® | 0.573 | 1.4 |
| Mean Flow over Head Range | - | 1.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 1.5 | 1.200 | 2.0 | 3.000 | 3.0 | 7.000 | 4.5 |
| 0.200 | 1.7 | 1.400 | 2.1 | 3.500 | 3.3 | 7.500 | 4.7 |
| 0.300 | 1.8 | 1.600 | 2.3 | 4.000 | 3.5 | 8.000 | 4.8 |
| 0.400 | 1.7 | 1.800 | 2.4 | 4.500 | 3.7 | 8.500 | 5.0 |
| 0.500 | 1.6 | 2.000 | 2.5 | 5.000 | 3.9 | 9.000 | 5.1 |
| 0.600 | 1.5 | 2.200 | 2.6 | 5.500 | 4.0 | 9.500 | 5.2 |
| 0.800 | 1.7 | 2.400 | 2.7 | 6.000 | 4.2 | | |
| 1.000 | 1.8 | 2.600 | 2.8 | 6.500 | 4.4 | | |

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## Storage Structures for Storm

### Tank or Pond Manhole: AR-2:27, DS/PN: AR-2:1.008

Invert Level (m) 37.300

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 131.0 | 1.800 | 736.0 |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| FEH Rainfall Version | 2013 |
| Site Location | GB 248483 843245 NH 48483 43245 |
| Data Type | Point |
| Cv (Summer) | 0.750 |
| Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 200 |
| Climate Change (%) | 42 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| AR-2:1.000 | AR-2:19 | 15 Winter | 200 | +42% | | | | |
| AR-2:1.001 | AR-2:20 | 15 Winter | 200 | +42% | | | | |
| AR-2:1.002 | AR-2:21 | 15 Winter | 200 | +42% | | | | |
| AR-2:2.000 | AR-2:17 | 15 Winter | 200 | +42% | | | | |
| AR-2:2.001 | AR-2:18 | 15 Winter | 200 | +42% | | | | |
| AR-2:2.002 | AR-2:22 | 15 Winter | 200 | +42% | | | | |
| AR-2:2.003 | AR-2:23 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-2:1.003 | AR-2:22 | 15 Winter | 200 | +42% | | | | |
| AR-2:1.004 | AR-2:23 | 15 Winter | 200 | +42% | | | | |
| AR-2:1.005 | AR-2:24 | 15 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-2:1.006 | AR-2:25 | 15 Winter | 200 | +42% | | | | |
| AR-2:1.007 | AR-2:26 | 2160 Winter | 200 | +42% | 200/480 Winter | | | |
| AR-2:1.008 | AR-2:27 | 2160 Winter | 200 | +42% | 200/15 Summer | | | |
| AR-2:1.009 | AR-2:28 | 2160 Winter | 200 | +42% | | | | |
| AR-2:1.010 | AR-2:29 | 2160 Winter | 200 | +42% | | | | |

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## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| AR-2:1.000 | AR-2:19 | 71.451 | -0.089 | 0.000 | 0.65 | | 88.6 | OK | |
| AR-2:1.001 | AR-2:20 | 63.076 | -0.074 | 0.000 | 0.76 | | 102.9 | OK | |
| AR-2:1.002 | AR-2:21 | 57.608 | -0.072 | 0.000 | 0.78 | | 126.9 | OK | |
| AR-2:2.000 | AR-2:17 | 68.652 | -0.118 | 0.000 | 0.10 | | 4.9 | OK | |
| AR-2:2.001 | AR-2:18 | 62.712 | -0.038 | 0.000 | 0.90 | | 45.0 | OK | |
| AR-2:2.002 | AR-2:22 | 57.113 | -0.117 | 0.000 | 0.46 | | 73.8 | OK | |
| AR-2:2.003 | AR-2:23 | 48.585 | 0.185 | 0.000 | 1.57 | | 72.8 | SURCHARGED | |
| AR-2:1.003 | AR-2:22 | 48.171 | -0.104 | 0.000 | 0.74 | | 228.6 | OK | |
| AR-2:1.004 | AR-2:23 | 43.948 | -0.087 | 0.000 | 0.82 | | 260.2 | OK | |
| AR-2:1.005 | AR-2:24 | 39.767 | 0.392 | 0.000 | 2.50 | | 262.1 | SURCHARGED | |
| AR-2:1.006 | AR-2:25 | 39.194 | -0.131 | 0.000 | 0.75 | | 262.4 | OK | |
| AR-2:1.007 | AR-2:26 | 38.682 | 0.082 | 0.000 | 0.04 | | 9.8 | SURCHARGED | |
| AR-2:1.008 | AR-2:27 | 38.681 | 1.231 | 0.000 | 0.05 | | 2.1 | SURCHARGED | |
| AR-2:1.009 | AR-2:28 | 35.890 | -0.110 | 0.000 | 0.16 | | 2.1 | OK | |
| AR-2:1.010 | AR-2:29 | 35.812 | -0.113 | 0.000 | 0.14 | | 2.1 | OK | |

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